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Modern Glass Mixtures[1]

Much Care Should Always Be Exercised in Producing First Melts with a New Color

By Dr. Oskar Lecher

Yellow and Brown Glasses

Yellow and brown are among the most difficult colors attainable in the production of glass, since it is very difficult to hit any certain definite color tint desired, the color of the melt obtained usually being of a lighter or darker shade. Nevertheless, the experienced glass melter is able, particularly in the case of yellow and brown glasses, to produce exactly the shades aimed at by varying the duration of the melt, increasing or reducing the smoke or draft, etc.

The fact that the production of a clear yellow glass is comparatively difficult is best demonstrated by the exceedingly large number of different methods and recipes. Among the substances used for the production of yellow glasses are the following:—Antimony, cerium oxide, uranium oxide, chromium, manganese, iron, silver, cadmium, sulphur, flowers of sulphur, sodium sulphide, sulphuric acid; also graphite, retort carbon, anthracite, charcoal, sodium tartrate, wheat, rye and rice flour, cherry kernels, chippings of alders, poplars and birch trees, millet, even dry cow dung and horse hoofs.

Of all these substances, only the following will give reliable results:

Light yellow-Rhine wine bottle brown: Manganese oxide and iron oxide;

Brownish orange-mahogany brown: Sulphur in glasses free of lead;

Fiery canary yellow: Cadmium with or without sulphur, particularly in lead glasses;

Greenish yellow: Uranium oxide, eventually with chromium oxide;

Reddish-orange: Uranium oxide with selenium;

Red-brown: Carbon powder, especially charcoal powder.

All other tints, such as topaz, amber yellow, leather brown, yellowish brown, anna yellow, antique yellow, etc., are produced by modifications of the above coloring agents.

Antimony alone colors lead glasses exclusively and does not give good color effects at that. Silver cannot be used in the melt but gives very beautiful tints in glazings. Cerium is expensive, unreliable, and without special advantages. The coloring effects of the entire group of organic coloring agents, from graphite to horse hoofs, are much more effective and reliably produced by charcoal powder.

Most reliable results are doubtlessly obtained with the manganese oxide and iron oxide colors, although on account of the varying percentages contained, each lot of manganese oxide purchased must be analyzed and the amounts added be calculated accordingly. The exact color tint desired is produced by adding a little more of the oxide than actually required, burning out the excess until the desired shade has been reached.

By using sulphur in open glass pots, exact color tints are obtained with difficulty only. The melt must be closely observed and controlled, and the color of the mass be modified by regulating the smoke or draft accordingly.

Carbon, flour, and other organic coloring agents cause much foaming; hence the melting pots should not be entirely filled. The color burns out easily, and the glass is difficultly refined, remaining somewhat chalky in most cases.

Cadmium and uranium oxides give good and reliable color tints, particularly in lead glasses.

Quite frequently, coloring agents cannot be analytically determined in yellow or brown glasses; in this case sulphur or carbon must have been used for coloring.

Much care should always be exercised in producing the first melts with a new color. Throughout refining, samples must be taken at regular intervals and the color closely controlled. If the tints are somewhat darker than required, nothing should be attempted, whilst if they appear too dark, addition of arsenic or prolonged heating will lighten up the melt. Too light a melt is darkened by the addition of more coloring matter (mixed with glass mixture, of course) or by sharp blowing.

The following tables give a number of reliable mixtures

[1] *Continental Metallurgical and Chemical Engineering.*

for the production of various color tints for the different furnaces available and the qualities of glass desired:

	Red brown				Light
Sand	100	100	100	100	100
Sulphate	26	32.5	—	3	—
Lime	37	22	22	14	12
Phonolite	10	—	—	—	—
Manganese oxide	5	7.5	10	2	6
Iron oxide	5	—	2	2	—
Charcoal	1.5	0.5	—	—	—
Fluorspar	10	7.5	—	2	—
Soda ash	—	—	33	35	24
Flowers of sulphur	—	—	—	0.6	—
Potash	—	—	—	—	10
Copper oxide	—	—	—	—	0.8
Potassium bichromate	—	—	—	—	0.5

	Orange yellow				Opal
Sand	100	100	100	100	100
Soda ash	13	18	24	20	—
Potash	20	18	16	18	35
Lime	18	20	19	20	10
Charcoal	4	2	4	—	—
Sodium tartrate	6	—	—	2	—
Flowers of sulphur	1	1	0.5	—	—
Manganese oxide	—	1	—	3	—
Saltpetre	—	—	—	—	2
Iron oxide	—	—	—	1.5	—
Borax	—	—	—	—	2
Sodium biuranate	—	—	—	—	1
Minium	—	—	—	—	6
Bone ash	—	—	—	—	20

	Leather brown-opal	Non-transparent
Sand	100	100
Potash	45	6
Cryolite	—	6
Fluorspar	—	12
Feldspar	—	68
Soda ash	—	16
Iron oxide	3	16
Manganese oxide	20	16
Tin oxide	2	—
Lime	12	—
Bone ash	24	—

	Amber yellow				Topaz yellow brown			
Sand	100	100	100	100	100	100	100	100
Soda ash	12	20	30	33	33	34	38	12
Potash	20	16	5	—	—	—	—	22
Lime	12	15	7	16	15	18	17	12
Minium	6	—	17	—	—	—	—	8
Borax	5	4	1	—	—	—	—	2
Cadmium sulphide	6	—	—	—	—	—	—	—
Sodium sulphide	1	—	—	—	—	—	—	—
Manganese oxide	0.3	3	—	—	—	1.5	2.5	—
Charcoal	—	4	—	1.5	1.3	1	—	—
Saltpetre	—	—	2	—	—	—	—	4
Sodium biuranate	—	—	1.2	—	—	—	—	1.2
Antimony	—	—	0.25	0.25	—	—	—	0.25
Iron oxide	—	—	—	2.5	2.5	—	1.5	—

	Canary yellow			Transparent
Sand	100	100	100	100
Soda ash	8	15	—	—
Potash	15	11	45	33
Cryolite	12	12	—	—
Lime	14	10	8	16
Borax	2	2	—	2
Sodium biuranate	1	—	—	1
Potassium bichromate	0.1	—	—	—
Sodium tartrate	—	—	—	1
Cadmium sulphide	—	2	1.5	—
Flowers of sulphur	—	0.5	0.3	—
Saltpetre	4	—	—	2
Bone ash	—	—	30	—
Tin oxide	—	—	2	—

Selenium Ruby

Selenium ruby glass, of shining cinnabar red color, has been frequently used of late for the production of solid glass, eventually covered with irisating crystal casing, or finally as transparent casing for wine glasses and bowls, as well as non-transparent for cups, vases and liquor mugs.

The process of production is comparatively difficult and is practised by only a few glass works in Germany and Bohemia, but in America it appears to have become more widely used.

The following mixtures will give satisfactory results:

	Hollow Glass	Pressed Glass
Sand	100	100
Calcined soda 98%	29.5	28.5
Calcined potash 98%	25	0.5
Lime spar	—	34.5
Heavy spar	—	—
Zinc oxide	21.5	—
Borax	1.5	—
Selenium	1.5	1
Cadmium sulphide	1.5	1.5

	Hollow Glass	Pressed Glass
SiO_2	63.08%	72.22%
Al_2O_3	0.82%	0.76%
Fe_2O_3	0.03%	0.04%
CaO	0.04%	13.96%
BaO	— %	— %
MgO	0.01%	0.24%
Na_2O	10.46%	11.27%
K_2O	9.89%	0.19%
ZnO	13.58%	— %
Se	0.89%	0.60%
CdO	0.81%	0.91%
B_2O_3	0.48%	— %

Also two mixtures for flesh colored glass, red and white turbid.

Sand	100	100
Zinc oxide	24	8
Potash	30	30
Soda	5	12
Borax	10	2
Bone ash	10	3
Cryolite	12	7
Feldspar	—	20
Fluorspar	—	20
Selenium	1.2	1.3
Cadmium sulphur	2	3.5
Flowers of sulphide	—	0.5

The following are two mixtures for the production of coral red glass, made of combinations of copper ruby and selenium ruby. In the same way, gold ruby and selenium ruby, as well as gold ruby and copper ruby may be mixed, which may then be combined with the difficult opal glasses so that all possible tints ranging from pale flesh red to deep blood red may be obtained at wish.

	Garnet red	Opal
Sand	100	100
Potash	20	14
Soda	12	16
Cryolite	—	12
Saltpetre	2	2
Minium	—	10
Cuprous oxide	0.30	—
Sodium tartrate	0.45	—
Stannous oxide	0.25	0.35
Borax	4	5
Ground marble	14	—
Selenium	0.18	0.14
Gold	—	0.04

As usual, the coloring agents are carefully mixed with a small amount of sand and the mixture added to the main body, shovelled through and charged into the glass pots. In order to prevent too large a volatilization of selenium, the pots should be closed and the openings luted with clay. If a sample shows the color of the flux to be too light, a little more selenium, mixed with a small quantity of the glass mixture is added.

The glass is blown as rapidly as possible. After cooling off quickly, the articles are reheated almost to softening and

this temperature maintained for about 1 or 2 minutes. They are then cooled off and transferred into cooling furnaces from which, after a treatment of 40-48 hours, they emerge colored deep red. If incorrectly treated, the color of selenium glass is more or less yellow, but may always be transformed into the color of copper ruby by another annealing and cooling treatment.

Yellow Silver Glazing

It has been observed above that a really beautiful and uniform coloration of the glass body is but rarely and unreliably attained by the use of silver preparations. In order to be able to make use of the beautiful shining yellow colors in the glass industry, the glazing process must be resorted to by which a superficial coloration of the glass plate is obtained so that it is possible, by applying the color basis after drawings, to produce a yellow figured glass. By means of a similar process, the same glass may be provided with a red copper oxide glazing, thus allowing of a still greater variety.

For the production of good coloring effects, the composition of the glass body itself is of greatest importance. Although glazings may be obtained on almost any kind of glass except the very viscous varieties, certain compositions are decidedly better adapted to this process than others. According to the results of the investigations of Ebell and Zsigmondy, best results can apparently be obtained with glasses melted in a reducing atmosphere as well as with glasses containing oxide of iron, or colored brown by carbon, etc.; also with sulphate glasses, which are particularly suited for this purpose. Bohemian crystal and potash-lime glasses are also claimed to give good glazings. The following table gives a few very good mixtures:

	I	II	III
Sand	100	100	100
Soda	20	20	—
Potash	15	10	—
Minium	5	—	—
Lime spar	12	10	22
Arsenic oxide	1	1	—
Saltpetre	1	—	—
Sulphate	—	—	48
Carbon	—	—	4

Selenium as discoloring agent is used as required.

Occasionally, the furnace atmosphere should be kept smoky.

The surface of the glass body must be as evenly polished as possible and absolutely dry and free from fat.

The glazing paste is produced as follows:

One or two parts of a silver salt—oxide, carbonate, or chloride of silver—are triturated in a porcelain vessel or in a ball mill with ten parts of plastic (pipe) clay or clay containing iron, until a perfectly uniform and homogeneous mixture of very finest grain has been obtained. Silver oxide possesses a much more pronounced and intensive glazing effect than the other silver salts, even if, in view of its higher silver contents, quantitatively smaller amounts are used. If the glazing paste is to be painted on with oil, the mixture is triturated with oil of turpentine and applied to the dry and clean surface of the glass body. The paste may equally well be prepared, however, by triturating with water, and adding a little sugar syrup or rubber.

The glass painted with the glazing paste is now heated in a muffle, while for sheet glass a spreading furnace is used. The best muffle temperature should be determined experimentally for every grade of glass. Too high a temperature softens the glass, the clay admixture melting into the glazed surface so that its removal becomes impossible. At too low temperatures, the glazing produced is weak and speckled.

After leaving the muffle, the glasses are carefully cooled, and, finally, the clay admixture rubbed away. This clay powder contains a rather considerable amount of silver and may be used with a new silver or rubber addition, or the silver may be regained in the form of silver chloride by dissolving in nitric acid and precipitating the nitrate by addition of hydrochloric acid to the nitric acid solution.

The larger the quantities of silver used and the higher the burning temperatures, the darker the colors produced, other conditions being aqual. The range of colors producible with silver salts extends from light yellow over orange to red-yellow. An originally weak glazing may be reenforced by a second application, which may best be made on the reverse side. Only if this is found to be impossible should the second glazing be applied directly on the first, since, in this case badly colored, opaque, and irregular colors are often produced.

The glazing process as a whole is not difficult but requires a certain degree of experience on the part of the operators, a considerable amount of experimental preparatory work, and careful observations of all chief points of the operations.

Glass Technologists Hear Interesting Paper

At the opening meeting of the Society of Glass Technology for the Session of 1927-28 in Sheffield, England, on October 11th, the paper reviewed below was presented.

OPAL GLASS. CRYSTAL GROWTH AND IMPACT BRITTLENESS. By J. F. Hyslop, B.Sc. (A Communication from the Research Laboratories of the General Electric Co., Ltd.)

It was shown that the fluoride particles in an opal glass were globular if the viscosity of the glass was high. With low viscosity the particles assumed characteristic crystalline form. In an opal glass heated under the critical point found by Gehlhoff and Thomas, the logarithm of the particle size was directly proportional to the reciprocal of the absolute temperature. That is, the particle size, for equal times of heating under the critical point, was inversely proportional to the viscosity of the glass. Impact brittleness in opal glass was associated with several factors. The chief cause of brittleness was the tendency of the glass to produce sharp angular crystals and these might be formed by:

(a) The tendency of the matrix to precipitate silica. If the opal was susceptible to this secondary devitrification, a careful choice of working temperature was necessary if the absence of brittleness was desired.

(b) The tendency of the glass to grow angular instead of globular fluoride particles. This happened in a glass of low viscosity and such a glass was brittle at low and high working temperatures.

Impact brittleness had in one instance been associated with heterogeneous glass and in this connection it was shown that the size of cullet was an important factor in the production of a homogeneous glass.

Automobile Glasses

By E. Ward Tillotson[1]

In undertaking to evaluate a material that is in extensive everyday use there is a temptation to suggest that it is a key material and that the whole of industry and civilized life would fall if it were to be made unavailable. This temptation is particularly strong when glass is under discussion, and it is not without reason from certain points of view. If one is candid, however, he must say that the automobile would be able to operate efficiently and in general satisfactorily without a bit of glass in its make-up. The principal function of glass in its application to transportation has to do with questions of comfort and of convenience. The use of sheet glass for the windshield and for windows and the application of other kinds of glass as a protective material to the lighting and signaling system and to the dashboard equipment constitute the repertoire of glass in the present-day automobile. Yet it is probable that no one would purchase a glassless automobile, for the convenience and comfort that glass provides have come to be inseparably associated with modern transportation.

E. WARD TILLOTSON

Glass is one of the materials that was not created particularly for the automobile, and, indeed, with a few possible exceptions, no modifications have been made to adapt it for this use. One might almost say that a sheet of glass has been set up as a windshield and a car has been built around it. The development of the automobile, nevertheless, has had the effect of making profound changes in one of the branches of the glass industry. The manufacture of plate glass is undergoing an evolution, long overdue, that promises to revolutionize completely the methods of producing that material.

Manufacture of Plate Glass

Although plants for the manufacture of bottles and window glass have been in successful operation for over a century, plate glass has been produced successfully in this country for only about forty years. Between 1850 and 1870 several attempts were made to manufacture rough-cast plate glass, and while a fair quality of output resulted the efforts were discontinued chiefly for economic reasons. In 1869, however, there appeared a man who was to place the industry on a permanently sound basis. In that year John B. Ford built a factory for the manufacture of polished plate glass at New Albany, Ind., and operated it successfully for several years. Reverses came, however, and he withdrew and built factories successively at Louisville, Ky., Jeffersonville, Ind., and Creighton, Pa. Although most of the earlier attempts were not permanently satisfactory, it is to be supposed that Mr. Ford profited by the experience, for the factory at Creighton became markedly successful and was probably the first plate glass factory to pay for the large investment involved. This plant was built in 1881 on the bank of the Allegheny River, about twenty miles north of Pittsburgh, when Mr. Ford was over seventy years of age, and later formed the nucleus about which the Pittsburgh Plate Glass Company was organized. The whole glass industry received a great stimulus at about this time by reason of the discovery of natural gas in western Pennsylvania. It was a cheap fuel, ideal for glass-manufacturing, and its use was responsible in no small degree for the successful establishment of plate glass manufacture.

Thus came into being an industry using methods and, at first, machinery imported from Europe. Naturally, labor-saving machinery has been utilized more and more, but until recently no fundamental changes were made in its technology. The past few years, however, have witnessed innovations that probably are to be adopted generally in the manufacture of plate glass. It is of interest, therefore, to give a brief description of both the old and the new methods of manufacture.

OLD METHOD.—What is referred to as the "old" method is still employed in perhaps 90 per cent of the present production and doubtless will continue in use for many years. The glass is melted in open pots, the size of which is determined by the size of the casting table. The average capacity is about 2,000 pounds of glass, which is sufficient for a casting table 14 by 24 feet, or for a 300-foot sheet of glass, but plates of glass are being rolled which contain 400 square feet. The melting furnaces are rectangular, regenerative furnaces containing sixteen to twenty pots arranged in two rows on opposite sides of the furnace. As mentioned, nearly every operation is carried out with the help of mechanical appliances. The batch is introduced into the heated pot with the assistance of a large iron ladle, into which the batch is shoveled and which is commonly operated by hand. Mechanically operated, semi-automatic charging ladles have been developed which are operating with satisfaction in several plants. The pot is charged in three fillings, in order to secure as full a pot as possible; and after the melting and refining period, which requires about twenty hours, the furnace is allowed to cool to bring the glass to the correct casting temperature, which is about 1,000° C. The entire cycle of operations requires about 25 hours. When the glass is ready for casting, the pot is taken from the furnace and any impurities on the surface of the glass are removed. The pot is then grasped by a clamp suspended from a motor-driven traveling crane and is brought to a position over the casting table. The casting operation consists in tipping the pot and at the same time moving it across the table so that the glass is distributed more or less uniformly just in front

[1] Assistant Director, Mellon Institute of Industrial Research of the University of Pittsburgh. Paper presented at meeting of Div. of Ind. and Eng. Chemistry, American Chemical Society, Detroit, Mich., Sept. 7, 1927.

of the roller. The roller, which is about 30 inches in diameter, is then drawn over the glass, an operation which requires about one minute. By this time the plate is cooled sufficiently to be transferred to the lehr. The sheet is too soft, however, to be supported on lehr rods, and until it has cooled further it rests on the floor of the lehr and is pushed mechanically from one compartment to the next. These compartments, usually five in number, are so arranged that the plate follows a zigzag course, for easier mechanical operation. The plate then advances into a straight, mechanically operated rod lehr, which is about 500 feet long and in which the annealing operation is completed. This type of annealing lehr was introduced about 1900 and marked a considerable advance in plate glass making, as formerly it had been the custom to anneal the plates in kilns. After passing through the lehr the plates are placed on cutting tables and cut into the required sizes. These tables are arranged to tilt to provide for the easy handling of the larger sheets, which are transported by overhead traveling cranes to the storage or to the grinding room.

The grinding and polishing operations now generally employed in the United States represent the principal advances in plate glass technology. Previously plates were placed on a rectangular table which moved from side to side, and the grinding was accomplished by the rubbing action of the grinding tool, which had a reciprocal motion at right angles to that of the table. At present the sheets are set with plaster of paris on a circular table which may be as large as 35 feet in diameter, the various sized sheets being fitted together so that the table is filled completely. The table rotates and the grinding tools, which are blocks of cast iron set in the under surface of two smaller circular tables, revolve slowly by reason of friction with the glass surface. Water is supplied to the table, and at first coarse sand, then continually finer sand, and finally emery. After the grinding has been completed, the table with the glass is moved to the polishing room, where the polishing operation is carried out in a similar way, but with a modified mechanical arrangement, and, of course, with the use of felt blocks and of rouge for finishing. The glass is then removed from the tables and reversed, and the operation is repeated.

A few years ago an improvement was made in the grinding operation which has not only eliminated much manual labor, but has also effected a saving in the time required for grinding. This invention consists of automatic devices by which the sand from the grinding tables is classified into several sizes and the required grade is returned at once to the table. The importance of this classification is indicated by the fact that 10 pounds of sand are required in the grinding of one square foot of surface. This innovation has perhaps halved the time of grinding, which at present is about an hour and a half for each surface. This period is to be compared with the 5 or 6 hours required in the original method of grinding and polishing. The use of the circular table for this purpose is usually referred to as the "Belgian system" and was introduced into the American industry in about 1890.

NEW PROCESS.—The new process of manufacturing plate glass differs from the old in the melting furnace and in the formation of the sheet as well as in the grinding and polishing mechanism. The melting is carried out in a continuous tank, a feature that eliminates the inconvenience of making and handling many small pots, and in general is more simple and economical for the production of large quantities of glass. Then, instead of rolling out the glass on a table, like pie crust, it is allowed to flow through a slot and between rollers onto a moving platform that carries it like a continuous ribbon through the annealing lehr. After annealing, it is necessary to cut it, as before, into sheets of suitable size.

The grinding and polishing processes which follow are decidedly novel. Instead of the rotary tables, a train of flat cars traveling on heavy steel rails is employed. The sheets of glass are mounted in plaster of Paris on the cars and the train passes progressively beneath a multitude of rotary grinding units, each of which is provided with a separate motor drive. After passing the grinding heads, the train proceeds beneath the polishing units, which are arranged and also operate much the same as do the grinding units. The glass sheets are then turned and the train returns to the starting point under similar series of machines on a parallel track. Thus, in one round trip both sides of the sheet are ground and polished in an almost continuous and automatic operation.

This continuous process is employed in one factory for the manufacture of windshields and is being developed in others for the production of the larger sizes of plate glass. According to present indications it promises to replace in time the current method of making plate glass.

Composition of Plate Glass

The term "plate glass" does not refer primarily to any definite composition, but to the method of manufacture and to the final form of the product. Any glass that has been rolled into a sheet and then ground and polished is properly called plate glass. The term also implies that the sheet shall be free from defects such as undissolved material, bubbles, striæ, and other faults which are common in glass for less exacting requirements. It is, perhaps, next to optical glass, the most carefully prepared and the most perfect of all the commercial glasses.

The batch formula and percentage composition of typical plate glass, in round numbers, are as follows:

BATCH FORMULA	*Pounds*	COMPOSITION	*Per Cent*
Sand	1,000	SiO_2	72
Limestone	320	CaO	13
Soda ash	310	Na_2O	15
Salt cake	65		
Charcoal	3		

Plate glass does not differ greatly in composition from window glass, but generally contains slightly more sodium oxide and slightly less calcium oxide. Moreover, slight differences exist in the composition of plate glass made at different factories. In addition to the composition given, small quantities of iron and aluminum oxides, undecomposed salt cake, and other "impurities" are present in the finished glass.

This composition is to a large extent a compromise that produces a glass of satisfactory resistance to weathering which may be melted under the conditions of time and temperature imposed and may be cast, rolled, and annealed without breakage. It must also be easily ground and

polished, operations which are highly developed in the art but which might well be given further scientific study. From the strictly chemical standpoint the composition of plate glass stands as it has been developed by the glass-maker during years of practice of his art.

The application of chemical knowledge to glass-making has, however, swept away much of the mystery with which the art was formerly surrounded and has led to simplification of the batch formula and to improved control of the melting conditions. Glass is a synthetic chemical substance, the formation of which is brought about by fusing the ingredients or, in the language of the industry, by "melting" them. The process is, however, more complex than a simple melting operation. Chemical decompositions take place, gases are evolved, and new chemical compounds are formed and, while the chemical constitution of the product is still somewhat obscure, it provides the very useful material with which we are all familiar.

Moreover, glass-making draws heavily upon chemical industries for certain of its raw materials. Not only are the materials used for producing colors in glass products of chemical manufacture, but the important ingredients, soda ash and salt cake, are distinctly chemical products. It is of interest to note the favorable effect upon the glass industry generally by the introduction of soda ash manufactured by the Solvay process. Because of its greater purity it became possible to produce soda-lime glasses so nearly colorless and of such a high quality as to supplant for many uses the more costly potash-lead glasses that had formerly been necessary for the finer grades of glassware. The plate glass industry has profited in consequence by the availability of soda ash and salt cake of a high and a constant degree of purity. Chemical control of the raw materials used in the batch is of special importance in maintaining a constant composition, which is an aid in minimizing certain defects and in assuring a maximum yield of first-quality product. To that same end ceramic knowledge has been drawn upon for improvements in the composition and methods of manufacture of the melting pots. Ceramic study has resulted not only in the general use of domestic clays for this purpose, but also in a more satisfactory performance of the pot and a more consistent production of good glass, through the lessening of defects and the maintenance of standard and constant conditions throughout the several operations.

Science in the Plate Glass Industry

The contributions of the engineer of plate glass making are many. The development of ingenious mechanical appliances has not only supplanted much manual labor, but also has made for the production of a better product. The application of scientific principles in the construction and operation of the annealing lehrs and in the grinding and polishing operations has also resulted in economies and in an improved product. For example, the used abrasive is recovered and re-graded and the several sizes are applied in the grinding operation in an orderly sequence, with the result that the time required for grinding is materially reduced and a superior surface is produced.

It should not be supposed that chemistry and physics have completed their contributions to plate glass making. There are still problems in every operation involved that need explanation and difficulties that need correction. There are limits, however, beyond which it is scarcely possible to pass. The automotive engineer is interested in plate glass as a material of construction and in the possibility of producing a harder or more elastic, less breakable glass. In general, it is found that any given mechanical property of glass cannot be doubled or halved by any change in chemical composition. It seems probable, therefore, that no great improvements may be expected from changes in the glass composition.

Composite Glass

The problem is, however, being attacked from a different angle. Just as other multilayered or laminated products often possess superior mechanical characteristics, so it appears that laminated, or composite glass will be of particular use in automobile construction. This product, which has been in the developmental stage for a number of years, consists of two sheets of polished plate glass between which is cemented a sheet of transparent material, usually celluloid, the three sheets being joined together into a unified structure. In order that the finished sheet shall not be thicker than the customary (¼ inch) plate glass sheet, it has been necessary to grind and polish glass plates slightly under ⅛ inch in thickness, an operation that has required considerable specialized developmental work for its perfection. Several methods are in use for the manufacture of this composite glass. In general, however, the sheet of celluloid is placed between the two glass plates, the surfaces of which have been coated with the proper adhesive, and the "sandwich" so formed is placed in a hydraulic press where it is heated under pressure. The finished product is not only stronger mechanically than a similar single sheet of glass, but when it is broken only the glass is cracked, and the surprisingly good bond between the glass and celluloid prevents the glass from flying and the sheet retains its shape, consisting of a sheet of celluloid supporting the glass fragments.

Serious efforts are being made by several large companies to perfect this product technically and to reduce its manufacture to the routine of large-scale production.

Besides plate glass few other types of glass are to be associated with transportation. Mention should be made of signal glasses, however. The principles of psychology and of physics have been applied to select proper colors and to produce glasses possessing the correct spectral transmission. While this development was largely inspired by the needs of the railroads, its application in the realms of the automobile is constantly becoming more evident to automobilists and pedestrians alike.

Another and perhaps relatively minor development should be recorded here to illustrate a contribution of chemistry to this subject. A rear-view driving mirror that purposes to eliminate the glare from the headlights of cars following has been placed on the market. This mirror differs from the usual mirror in that the reflecting surface is not silver but lead sulphide. It is produced by chemical deposition, but outside of the fact that the operation is carried out with alcoholic solutions the details of the process have not been disclosed. The result is a mirror that reflects about 40 per cent of the light and appears to have a selective absorption for the more luminous part of the spectrum.

Inside Frosting of Incandescent Lamp Bulbs

Chemical Engineering Contributes to Better Lighting[1]

By Marvin Pipkin[2]

Like so many other chemical processes, the etching and frosting of glass is old in history, but young in technology. It has remained for the last few decades to see the process firmly established on a scientific basis; and for the last generation to see it develop into its present useful stage.

As will be later explained, frosting is a special case of the etching of glass. All etching is not necessarily frosting. The process applied to glass for the purpose of rendering it white and translucent, referred to as frosting, consists in the decomposition of the surface of the glass, with an attendant formation of crystals of the products of the decomposition on the glass surface. The result is that light which passes through the broken surface is diffused.

Frosting the outside of incandescent lamp bulbs has been resorted to for some time in spite of the inefficiency of the resulting product. Such bulbs were inferior to those of clear glass in their light-passing properties even when new, but in addition were difficult to keep clean and consequently became poorer with age. Efforts have been made for a number of years to apply the frosting to the inside of the bulbs and eliminate the accumulation of dirt on the bulb surface. These attempts have, however, only recently been successful because of mechanical difficulties. Not only was it a great deal more difficult to cause the reaction to take place inside the bulb, but, peculiarly enough, the bulbs which were made this way were much too fragile to withstand the further processing required in inserting the filament and sealing and exhausting the bulb.

Research, however, has shown a way to prevent this phenomenon, with the result that a bulb can now be produced which is practically as strong as one made of clear glass. The intensity of the light per unit of area from the new type of bulb increases only very slightly with the candle-power, and has only a small fraction of the intensity of a clear glass bulb. On the other hand, the frosting results in a very negligible diminution of the candle-power. In addition, it has been possible to reduce by 25 per cent the cost of bulbs to the consumer because it has been possible to standardize on but five lamp styles, instead of the forty-five previously found to be necessary.

A frosted, or as it is sometimes called, a matt etched surface, may be likened to a surface of water which is violently ruffled by a heavy wind. Due to the large number of diffraction surfaces presented, the surface is white. Simple etched surfaces, however, are comparable to water disturbed by a light breeze. The slight ripples produced are not sufficient to whiten the surface. But here the analogy ends, for not all glasses react similarly. The harder a glass is, the more difficult it is to frost, although any glass can be frosted if the solution used contains sufficient hydrofluoric acid and sufficient dissolved fluorides derived from the glass. It is apparent that in addition to there being enough of the corrosive agent present, there must also be sufficient dissolved material so that the solution of the decomposition products of the glass will force the equilibrium in the direction of crystallization. On the other hand, for proper frosting it is not desirable to allow the crystallization to be complete. The optimum conditions call for rapid solution and a rapid partial crystallization of the products on the surface of the glass. As will appear, this result is accomplished by the repeated use of the same frosting solution with the addition of sufficient fresh solution to maintain the etching properties.

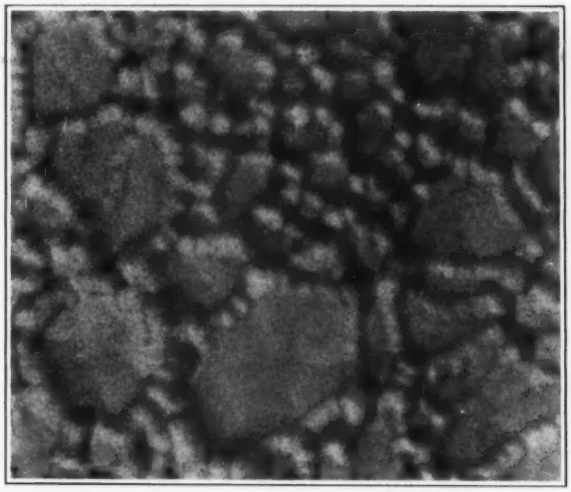

FIG. 1—FROSTED GLASS SURFACE BEFORE FORTIFICATION
Magnification X 1035

Fig. 1 shows a microphotograph of a matt etched surface. The reader's attention is particularly called to the numerous sharp edges and the jagged appearance of the glass. Fig. 2, however, presents a smoothly curved surface. Nevertheless, the second photograph shows the desired type of frosting. An examination of these two surfaces reveals the method which is employed to strengthen the frosted glass. It was found empirically that if a freshly etched surface were subjected for a short time to additional etching action using instead of the ordinary solution, containing a large amount of dissolved glass, a solution somewhat weak and far from its crystallizing point, that the objectionable fragility was lost. It appears that when the sharp corners and jagged surface are changed to continuous curves, that incipient cracks are averted, in the same manner that castings, for instance, are strengthened through the use of fillets. The discovery of this further treatment, now known as fortification, is the basis for the present use of inside frosted lamp bulbs and constitutes a very simple means of producing a much desired result.

[1] *Chemical & Metallurgical Engineering*—Vol. 34, No. 11 (Nov., 1927).
[2] Incandescent Lamp Department, General Electric Company.

While it is known that different kinds of glass require different frosting solutions, it is fortunately true that 90 per cent of all incandescent lamp bulbs are made of soda lime glass. As a consequence, much research has been necessary in looking for the most suitable solution for this purpose. When the exact nature of frosting as compared with etching became known, however, the problem assumed a simpler aspect.[3]

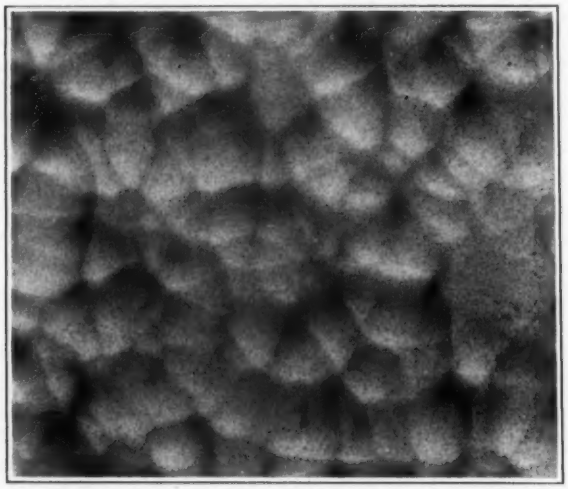

FIG. 2—FROSTED GLASS SURFACE AFTER FORTIFICATION
Magnification × 1035

If a 60 to 70 per cent solution of hydrofluoric acid is saturated with crystals of ammonium bi-fluoride containing 31 to 33 per cent of hydrofluoric acid, the most efficient known etching agent results. To produce matt etching, however, it is necessary to cut down the acid strength by the addition to the acid of soda ash, powdered glass or other materials, to insure crystal formation. To conserve solution on the other hand, the same effect is obtained as mentioned above by replenishing the original solution with new, of the following formula which is now standard:

Hydrofluoric acid (60 per cent)	37.3 per cent
Ammonium bi-fluoride (32-33 per cent HF)	29.0 per cent
Ammonium carbonate (28 per cent NH_3)	12.4 per cent
Soda ash	6.2 per cent
Water	15.1 per cent

About 6.8 per cent of the weight of the mixture is lost as CO_2, which leaves a solution analyzing as follows:

Hydrofluoric acid	27.0 per cent
NH_4F	29.0 per cent
NaF	6.3 per cent
H_2SiF_6	0.3 per cent or less
Water	37.4 per cent

This mixture is not used directly, but rather to keep the working solution up to an active ingredient content of approximately 26.5 per cent hydrofluoric acid and 22.7 per cent H_2SiF_6. The working solution is kept indefinitely and "butted up" as may be required. The fortifying solution is made from the above mixture by the addition of three parts of water. This latter solution is discarded weekly since it loses its fortifying properties as the crystal-forming components build up.

As a result of this development, the frosting industry is now in a position to consume annually about one million pounds each of hydrofluoric acid and ammonium bifluoride. In addition, something less than one-quarter million pounds of ammonium carbonate and one-half million pounds of soda ash will be required to produce about 400 million lamp bulbs each year.

Figs. 3 to 6 show the frosting machine which has been worked out by the Lamp Development Laboratory of the General Electric Company, for use in the plant of the

[3] An interesting paper on the Frosting of Glass by Mixtures Containing Hydrofluoric Acid and Alkali Fluorides, by C. D. Spencer and L. Ott of the Incandescent Lamp Department of General Electric Company was published in the *Journal of the American Ceramic Society*, Vol. 10, No. 6, June, 1927, pp. 402-410.—EDITOR.

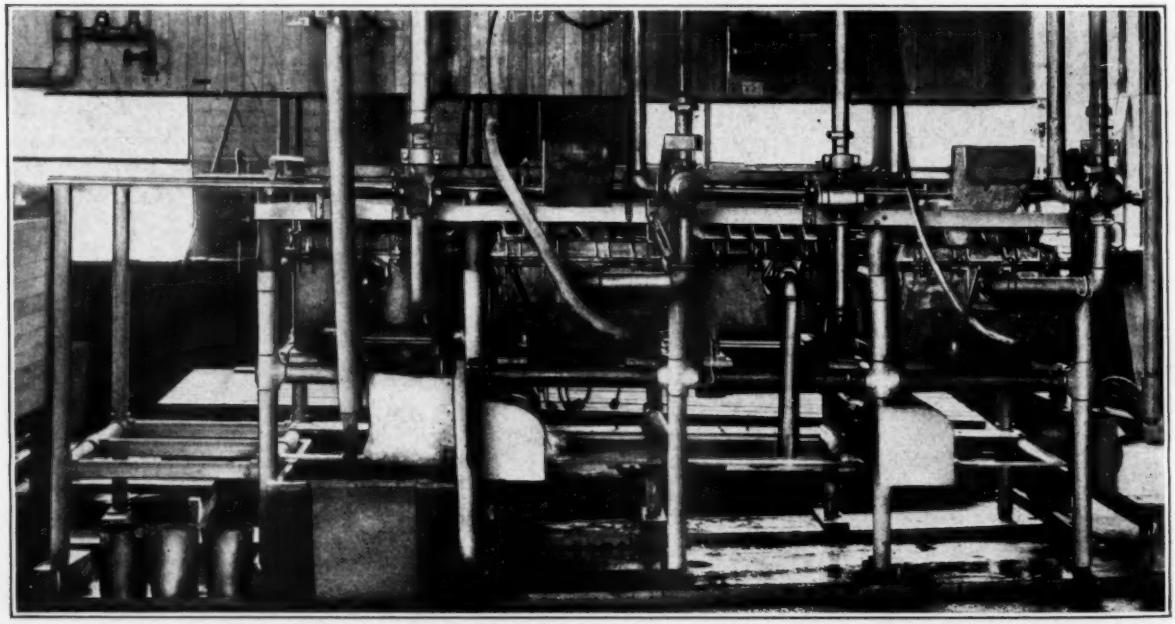

FIG. 3—SIDE VIEW OF THE FROSTING MACHINE USED AT THE PLANT OF THE PITNEY GLASS WORKS

Pitney Glass Works. Fig. 3 shows a side view of the entire machine, while Fig. 4 represents the same aspect of the apparatus diagrammatically. Fig. 5 and 6 are, respectively, full front and angular views from the operating end.

A little examination will show, that despite its simplicity, the machine is very well adapted to the purpose for which it was designed. One operator is able to turn out about 63,000 bulbs, completely frosted, fortified, washed, and dried, in eight hours. The average production on all sizes of bulbs amounts to 125 per pound of frosting mixture. Hot water consumption for washing purposes is 13 cu. ft. per 1,000 bulbs produced. It is obvious that the installation is economical.

In the last analysis, the machine consists simply of four cast bronze tanks equipped with sprays for distributing the wash water or solutions over the inner surfaces of the bulbs, funnels for catching and returning to the tanks the fluids leaving the bulbs, means for keeping the contents of the various tanks at the proper temperatures, and a suitable device for advancing the bulbs from one stage of the process to the next. The methods which have been employed in connection with these various functions are, however, sufficiently interesting to merit a considerably fuller description. It is entirely conceivable that some of the apparatus which was developed in this connection may also be applied in other parts of the extensive chemical engineering field.

All parts of the machine which come in direct contact with any of the acids are made of bronze, or in a few cases, of brass. The untreated bulbs are placed, 54 bulbs per tray, in lacquered wooden trays which slide in brass tracks mounted above the tanks. With reference to Figs. 3 and 4, the bulbs are first placed by the operator on the track above the tank at the extreme right. After treatment at the first tank, the tray is advanced to the second and so on, until it finally emerges at the left, and passes into the drying chute. The tanks, in order of the flow of bulbs are: frosting tank; wash tank in which recovered water from the last tank is used; fortifying tank; and finally, wash tank where the last traces of acid are removed with fresh water. Warm water at a temperature of 60 deg. C. is supplied to the wash tank D through the pipe and valve indicated in

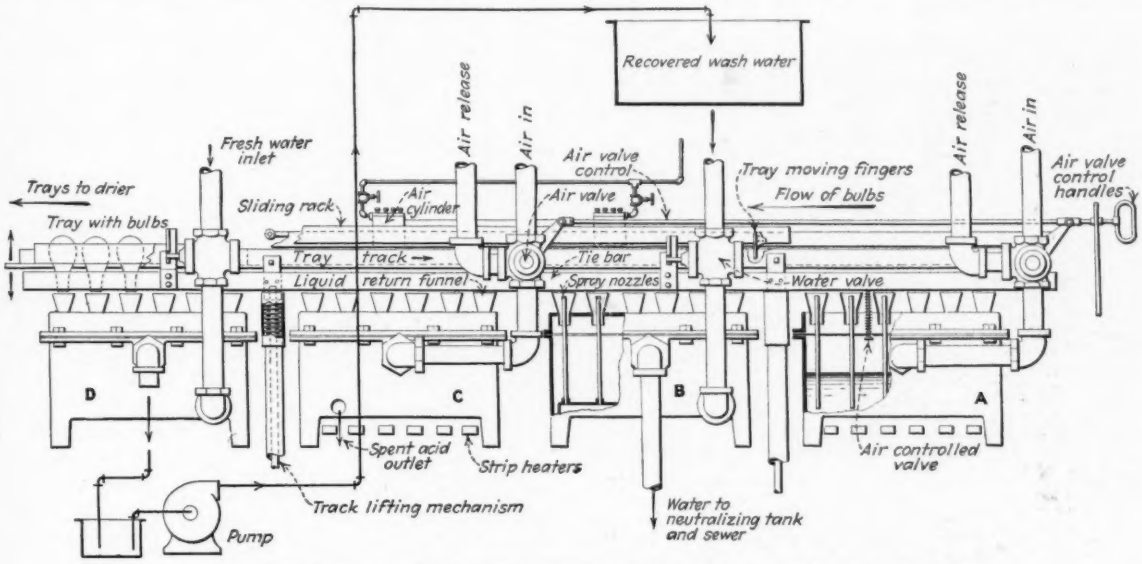

FIG. 4—SKETCH SHOWING IN DETAIL A SIDE ELEVATION OF THE FROSTING MACHINE

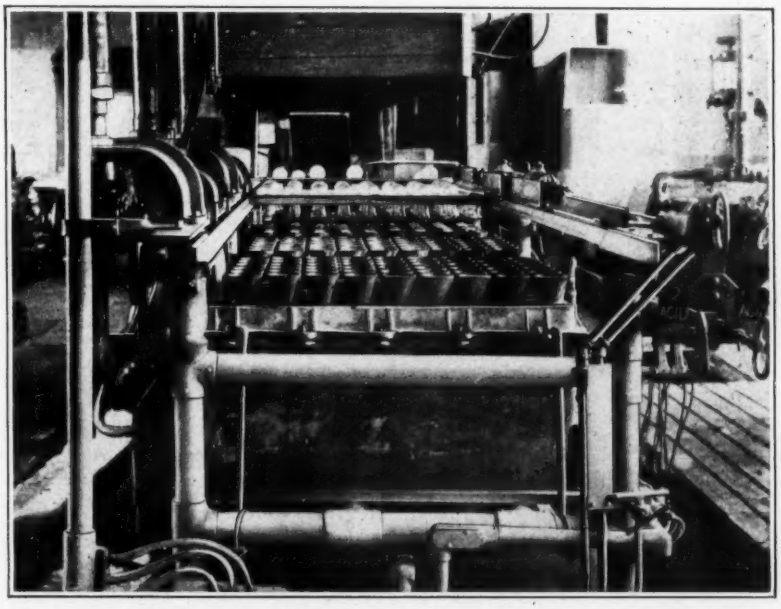

FIG. 5—VIEW OF THE FROSTING MACHINE FROM THE OPERATING END
Looking Toward the Drying Chute

Fig. 4. The overflow from this tank is collected in a sump from which it is pumped to an overhead tank for delivery to the first wash tank B. The overflow from B is first neutralized with lime and then discharged to the sewer. Frosting acid and fortifying solution are added when needed to tanks A and C respectively, by means of the large funnels plainly shown at the left in Figs. 5 and 6. The solutions in these tanks are maintained at about 57 deg. C.

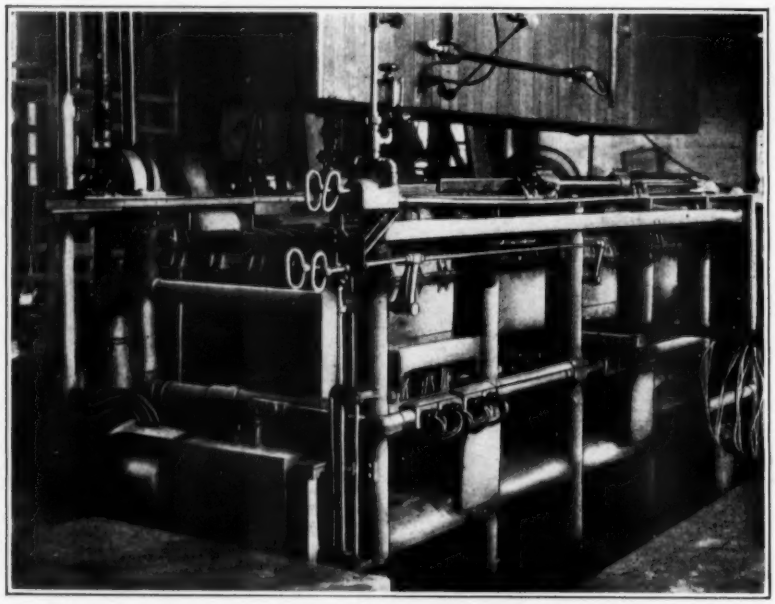

FIG. 6—ANGULAR VIEW OF THE FROSTING MACHINE FROM THE OPERATING END

by means of strip heaters placed beneath the tanks. The wash tanks are not heated, as a supply of thermostatically controlled hot water is available.

Examination of Fig. 4 will show that the track which carries the bulb trays is capable of being raised or lowered. This is accomplished by means of an air cylinder, not shown, which operates push rods working through the legs of the machine, by means of a series of racks and gearing. Thus, the trays of bulbs may be lowered toward the small funnels above the tanks, or raised so that the necks of the bulbs will clear the spraying mechanism. When the bulbs are in spraying position above any tank or tanks the fluids can be forced through the nozzles into the bulbs, by 1½-pound air admitted above the solutions in frosting tank A and fortifying tank C; or by the pressure of the water in wash tanks B and D. Handles beside the operator control the valves admitting air to the acid tanks. The water valves, on the other hand, open automatically when a tray is lowered over either of the wash tanks. If it should so happen that there is no tray over one of these tanks when the track is lowered, the water valve moving mechanism is not tripped and no water is lost.

To accomplish the advancement of the trays through the machine so that the bulbs may receive the four successive steps of the process, another air cylinder is provided, as indicated on Fig. 4 and shown at the right on Fig. 6. This cylinder, by means of its piston rod, moves a rack back and forth a distance equal to the amount of movement required in displacing a tray from its position above one tank to the next in line. The rack carries four dogs or fingers which engage lugs at the back of the four trays in the machine, provided the trays are in the raised position. By operating the proper valves from his platform, the operator is able to advance all four trays simultaneously to the next position. When he has lowered the trays so that the necks of the bulbs extend into the spraying funnels, he can then return the rack to its former position, ready for the next advancement.

The operation of the machine is very simple. When any tray of bulbs has passed over the four tanks, it is pushed off onto the track leading to the drying chute. This completes the entire cycle for that tray. Previously, a large rack containing a number of trays of untreated bulbs has been pushed to a point near the operating platform. The operator places a new tray of bulbs on the track over the first tank and proceeds as follows: Any one tray is first lowered into position over the first tank A. Each bulb is now over a spray jet. The air valve for this tank is opened, closing the air-controlled valve shown in Fig. 4. The acid is allowed to spray the inside of the bulbs for a certain number of times and for a predetermined period. Meanwhile, the rack has been returned to position. The tray is raised and advanced by means of the air cylinder to the first wash tank. In the meantime, while the air pressure has been released from tank A, the air-controlled valve has opened automatically and allowed the acid to drain back. Then as the tray is lowered over the washing tank, B, the water valve opens automatically and washes the frosted surfaces. The treatment of the bulbs over tanks C and D corresponds to that over A and B respectively. It is evident, however, that all four operations are performed simultaneously, since there are four trays in the machine.

About 2 seconds is required for moving operations, about 5 seconds for loading and 21 seconds for spraying and washing with a total time cycle of about 30 seconds per tray.

As a consequence of the improvements and methods which have been mentioned above, inside frosted bulbs have now displaced clear glass from production for all common purposes.

Engineering Index Service

Everything has been completed looking to a comprehensive scheme for indexing the engineering literature of the world to be initiated the first of the year, with the new weekly engineering index service of The American Society of Mechanical Engineers. One thousand five hundred technical publications of the world appearing in 17 languages in 37 countries are received in the Engineering Societies Library, New York. The index items will be printed on cards and mailed weekly to the subscribers to the new service. This project was authorized by the A. S. M. E. Council at its St. Louis meeting on October 8, 1927.

Progress in Gas Producer Practice

By Wm. B. Chapman[1]

(Concluded from the November issue)

Top and Bottom Agitation

The mechanical producers for bituminous coal now on the market provide considerable agitation in the top of the fire-bed but with the exception of the Chapman producer little or no special agitation is provided for the bottom of the fire-bed where the fire is hottest and the trouble begins. In this country agitating the upper portion of the fire-bed exclusively has more than doubled the capacity of gas producers, while in Europe the capacity has been more than doubled by agitating the lower portion of the fire-bed exclusively. Neither of these methods is complete in itself. All producers require some agitation at the bottom of the fire-bed, and if bituminous coal is used the upper portion of the fire-bed should also be vigorously agitated.

In this discussion the writer has tried to stick to the fire-bed and how it is manipulated. Questions of types of machinery are unimportant except in so far as they affect the quality of gas and the ease with which it is made.

Most of the different makes of mechanical producers in Europe, which have no automatic feed have been supplied with Chapman automatic feeds and surface agitators, and, much to the gratification of the users, the capacity has been nearly doubled, the quality of the gas has been greatly improved and the hand-poking reduced to practically nothing.

The following data is typical of results in Europe:

Chapman Agitator for Marne Gas Producer of 2.6m = 8′-6″ diameter. Tests made at the Steel Company of Scotland, Blockaire Works. (Comparison with a gas producer of the same type of 2.75M = 9′ diameter. Analysis of coal was volatile matter 33.5, ashes 13.92, moisture 8.05, fixed carbon 44.44.)

Heat value—10,432 B.t.u.

Tonnage gasified in 24 hours without agitator 15.1 tons.

Tonnage gasified in 24 hours with agitator 28.6 tons.

Pounds gasified per square foot without agitator 19.7.

Pounds gasified per square foot hour with agitator 42.1.

Average analysis of the gas without agitator:

CO_2	CO	H_2	CH_4	N_2	B.t.u. low value
8.5	20.9	14.9	2.5	53.2	130.1

With agitator.

CO_2	CO	H_2	CH_4	N_2	B.t.u. low value
5.9	25.1	14.3	2.2	52.5	140.1

Increase capacity 114%. Increase in heat value 7½%. 7½%.

Chapman Agitator for Kerpely Gas Producer of 2.86m = 9.38 feet diameter. Analysis of coal: De Fricklen Mines —Volatile matter 31.6, ashes 5.7, fixed carbon 61.4.

Tons gasified in 24 hours without agitator, 17 tons.

Tons gasified in 24 hours with agitator, 27.5 tons.

Average analysis of gas without agitator:

CO_2	CO	CH_4	H_2	N_2	B.t.u. low value
9.6	22.6	2.8	13.2	51.8	135.2

With agitator:

CO_2	CO	CH_4	H_2	N_2	B.t.u. low value
4.68	26.6	2.8	14.7	51.19	151.4

Increase in capacity 46%.

Increase in heating value 12%.

The following data are given not because they are "typical." They should be but are not. They represent what is being done with a Chapman producer in an unusually well managed steel works.

Actual results obtained from this producer using Eastern gas coal and operating with steam jet blower, during period March 23 to March 29, 1926.

	Steam Press. (av. for day)	Blast Pres. (av. in H_2O)	Blast Temp. (av.) °F.
March 23	92	7.2	123
March 24	90	7.4	125
March 25	83	6.1	119
March 26	90	7.5	125
March 27	80	4.3	117
March 28	67	3.8	115
March 29	73	5.2	118

The average gas analysis for the entire week obtained from seven 24-hour continuous samples was:

CO_2	Ill.	H	CO	CH_4	B.t.u.
4.3	.6	12.2	26.8	3.4	160

Average gasification rate for the entire run was 3,600 pounds of coal per hour or 46 pounds per square foot per hour.

On March 30 a large Coppus turbo blower was installed and the average analysis over a 96 hour period was as follows:

CO_2	CO	H	Ill.	CH_4	B.t.u.
4.1	26.2	10.2	.8	3.5	158

This was based on four 24-hour continuous gas samples.

The average coal gasified per hour was increased to 4,800 pounds or 61.5 pounds per square foot per hour.

Water Jacketed Producers

It is most economical to operate a producer at a temperature hot enough to make a small amount of clinkers all of the time. But it is not good economy to permit the clinkers to build out on the side walls until the gas maker manifests sufficient zeal to poke them off. A water-cooled wall is desirable if the producer is not to be poked at all, as otherwise it is necessary to used an excessively large amount of steam in the blast in order to prevent the ashes from sticking to the wall. Water jacketed producers are common in Europe but rare in this country.

A year ago the writer had an opportunity to operate a mechanical water gas generator as a gas producer. The generator had partially water-cooled walls and a mechanical clinkering beam 12″ high slowly revolving over the grate. The rate of gasification while operating as a gas producer was 100 pounds per square foot per hour, which is eight times as much as any hand-poked producer can be

[1] President, Chapman Engineering Co., Mt. Vernon, Ohio. This paper presented at National Meeting of the A.S.M.E. Fuels Division, St. Louis, October 10-13, 1927.

operated and twice the capacity of most mechanical producers. For three days no poker or measuring rod of any kind was put into the producer. Analyses were made every half hour for CO_2; these were checked with eight hour continuous samples. The average was 5.5%. No analysis was as high as six per cent and none as low a four per cent. This remarkable uniformity while operating at an unheard of high rate was due to the very complete mechanical agitation we had devised for the bottom of the water gas generator. An adaptation of this mechanical water gas generator to a gas producer is now being made.

Regulating Devices

For the past 22 years the author has advocated the use of more regulating devices for gas producers but the trade has not cared to bother with them. However, during the past year the situation has improved and now most of the leading manufacturers of gas producers include some indicating, recording and regulating equipment with every producer sold. The most important of these devices are: Pressure Regulator for maintaining constant pressure in the gas main, Recording Pyrometer for the temperature of the gas leaving the producer, Recording Thermometer for the mixture of air and steam in the blast. U tubes for indicating the pressure of blast beneath the fire-bed and also pressure of gas above the fire-bed or in the gas main, and a Steam Gauge. Some of these devices if intelligently used will save enough fuel to pay for their cost in a month. None of them require more than six months to pay for their cost. Another "instrument" that most producer gas houses require is an ordinary broom. In a dirty building fuel is never saved. It is wasted. If some of our producer gas houses were kept cleaner the manager might sometimes visit them and see where he is wasting his stockholders' money.

The most largely used mechanical producer in Europe is the Kerpely. In the United States it is only adapted for gasifying coke as it provides no surface agitation, which is very necessary for bituminous coal. The water jacket used with all Kerpely producers prevents clinkers from adhering to the side walls. The unusually large tuyere box of the Kerpely producer spreads the air blast and breaks the clinkers in a very satisfactory manner. It also gives about the right amount of agitation to the lower portion of the fire bed; that is provided the ashes can be kept at a substantially constant level about 9" above the top of the tuyere box. This however is a bit too exacting for the ordinary hit-or-miss American gas maker, and has only been accomplished satisfactorily in illuminating gas works where gas is made for sale instead of incidental to the manufacture of steel or some other product.

Producer Gas from Coke

A modified type of Kerpely producer is made by The United Gas Improvement Company and also by the Koppers Company. Both machines give excellent results when properly handled. These producers are designed especially for gasifying the cheaper grades of coke, the gas being used primarily for heating coke ovens. A full set of auxiliary equipment is always provided and is of invaluable assistance in maintaining the excellent efficiency and high degree of uniformity which is standard practice.

The coke used is usually about the following size:
1¼ to ⅝—50%, ⅝ to ¼—25%, under ¼—25%.
One company reports the following average:

On 1"	On ¾"	On ½"	On ⅛"	Through ⅛"
17%	22%	24%	24%	15%

This is much smaller fuel than is used in bituminous coal practice, which usually demands run-of-mill crushed to pass through a 4" ring. The gas made from the above size coke averages about 125 B.t.u. It seldom is less than 120 B.t.u. nor more than 130 B.t.u. The normal capacity of the producer is 24 tons a day for the eight foot inside diameter size and forty tons for the ten foot six inch size.

The analysis runs as follows:

CO_2	O_2	CO	H	CH_4	N
4. to 8.	.0 to .2	24. to 30.	10. to 13.	.2 to .6	52 to 55.

Both the United Gas Improvement Company and the Koppers Company control to a certain extent the operation of their equipment after it is sold and therefore are able to prevent the slip-shod, guessing methods which have been so prevalent with bituminous coal gas producers in many of our steel and glass works.

Producer Gas from Oil

During the past twenty years a few oil gas producers have come upon the market for a brief period and then have been withdrawn. Recently some real progress has been made with an oil gas producer used in connection with a 25 H.P. gas engine. The fuel per H.P. approaches Diesel results and the equipment is very much less expensive. The producer is about twice the size of a muffler on an automobile. Nothing as yet is being offered to the trade.

It is a long journey from the hand-operated gas producers of twenty years ago costing $2,500 to a completely automatic, water-jacketed producer costing four times that amount and having a capacity five times as great, complete with a full set of regulating devices, and requiring no hand-poking whatever. But I venture to predict that the trade will ultimately demand such a producer. Already it is almost accomplished.

Gas Producers for Boiler Heating

When such a producer becomes an accepted fact, new uses will be found for producer gas and both larger and smaller sizes will be made. The most important of these new uses will be the heating of steam boilers. The recent experiments of the British Government with a Wollaston producer located directly under a Cochran boiler have shown some of the possibilities in this field. Because there was no automatic feed and no automatic agitation of the surface of the fuel bed in the Wollaston producer it was necessary to use coke breeze instead of bituminous coal. The breeze contained 22.4% moisture and 18.5% ash and average 9,000 B.t.u. per pound. Ordinarily with this fuel the steam generating efficiency would be about 55% but with the special gas producer located directly beneath the boiler the efficiency was 80%. The stack gas contained 17.2 CO_2 and no smoke was made. All the steam required for blasting

the producer was obtained from the feed water pump exhaust. Full steam pressure was obtained in fifteen minutes on Monday mornings after the week-end shut down.

It is stated that hand operated producers of the Wollaston type using coke breeze are best adapted to boilers of from 100 H.P. to 200 H.P., but we see no reason why a completely mechanical producer of almost any desired capacity cannot be developed especially for boiler firing. Such an installation should have all of the advantages of pulverized coal and none of its disadvantages. The author believes that the underfeed producer possesses special merit for this purpose.

With the economic possibilities of producer gas as a boiler fuel once established, new types of boilers will be developed to take advantage of the possibilities of the new fuel. This will come later and inevitably.

[The author's closing remarks on producer gas for trucks and tractors have been omitted.—EDITOR.]

The Detection of Selenium in Decolorized Bottle Glasses

A paper by E. J. C. Bowmaker and J. D. Cauwood read at the October meeting of The Society of Glass Technology at Sheffield, England, has been reviewed in *The Pottery Gazette and Glass Trade Review* of November 1, as follows:

The essayist mentioned that, in connection with control work in a glass factory at which flint glass containers were made, it was occasionally desirable to examine bought flint cullet, and in view of the fact that either or both selenium-decolorized or manganese-decolorized cullet might be offered for purchase, it was of some interest to be able to distinguish the one kind from the other. With the object of devising a routine test for bought flint cullet, a method for detecting selenium in decolorized glasses was sought, and as no simple method appeared to have been described in technical literature, an investigation was undertaken to work out the details of a suitable test.

Owing to the fact that selenium in decolorized glasses was only present to the extent of about 0.001 per cent., it was clear that a very delicate test was required to detect the selenium, and therefore it was decided to determine the possibilities of making use of the green coloration produced by codeine and selenious acid in sulphuric acid. It must be noted that Schmidt (Arch. Pharm., 1914, 252, 161) stated that 0.01 gram of codeine phosphate in 10 c.c. of concentrated sulphuric acid would detect 0.00005 gram of selenious acid; therefore it appeared that the selenious acid-codeine test would have the required delicacy.

The preliminary work that was undertaken in this connection was described at considerable length by the essayists, as well as the way in which a standard procedure was ultimately developed, aided by advice from independent observers. The finally amended procedure resulted in the following standard practice: "To 2-3 grams of the finely powdered test glass, placed in a 25 to 30 c.c. platinum crucible, 15 to 20 c.c. of hydrofluoric acid and 2 c.c. of strong nitric acid are added. The solution is evaporated to dryness on a water-bath at a temperature of about 90° C., with occasional stirring with a platinum wire during the early part of the evaporation. To the residue after evaporation, 4-5 c.c. of strong nitric acid are added, and the solution again evaporated to dryness. The residue is then dissolved with 5 c.c. of 1:1 nitric acid and turned out into a 100 c.c. beaker with as little water as possible. The resulting solution is then divided into two equal portions, and each part treated separately as follows:

1. With the first portion a test for manganese is carried out by making the solution from the test glass up to 50 c.c. in volume with 1:1 nitric acid, and then adding 10 c.c. of N/100-silver nitrate solution. The beaker containing the solution is then stood on a hot plate, and about half a gram of ammonium persulphate added. When the mixture becomes hot, the pink color of permanganic acid will appear if manganese is present.

2. (a) If manganese is absent, then the second portion of the glass solution is treated in the normal way, i.e., 10 c.c. of sulphuric acid is added, the nitric acid and water evaporated off, cooled, and tested with codeine as already described.

(b) If, on the other hand, manganese is present, the solution from the glass is diluted to about 60 c.c. and bromine water added until the color is fairly strong. Ammonia is then added until the solution is faintly alkaline, after which the solution is brought rapidly to the boil and then filtered. The precipitate, which contains the manganese, is washed once with hot water and then rejected. The filtrate is treated with 10 c.c. of strong sulphuric acid and evaporated on a hot plate until the sulphuric acid has fumed for a few minutes. The solution is then allowed to stand until quite cold, when a piece of codeine sulphate about the size of a pin's head is added and stirred until dissolved, the solution then being heated to the fuming point, when a green coloration denotes the presence of selenium.

The trustworthiness of the above procedure was tested by applying it to manganese decolorized glasses free from selenium, to selenium decolorized glasses free from manganese, and to mixtures of manganese decolorized glass and selenium decolorized glass, and in every case the correct result was obtained. In fact, in a large number of tests the above procedure proved to be quite satisfactory for the detection of selenium in decolorized bottle glass.

It was, of course, important to ensure that the reagents were free from substances which interfere with the test, and also it was important to avoid contamination with copper, as during a recent series of supplementary tests it was discovered that under certain conditions copper in sulphuric acid will cause a green coloration when the codeine test is applied.

The Glass Industry

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CONTRIBUTIONS

THE EDITOR welcomes practical articles on all subjects related to GLASS MANUFACTURING. Such articles, if accepted, will be paid for at our usual rates.

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The Use of Color in the Glass Industry

The great increase in the use of color for decorative purposes since the close of the Great War is one of the most interesting developments of the post-war period. Manufacturers who have sensed the growth of this tendency early are now reaping a harvest that is showing itself on the credit side of the ledger.

Just what has been the underlying, psychological cause of the prevailing taste for gay colors would be difficult to formulate. It may have come as a natural reaction against the gloom, caused by years of suffering through which the world has gone since 1914. It may be a belated revolt against "Victorianism," characterized by the high silk topper and Prince Albert coat of our fathers, the indescribable apparel of the feminine part of the population of that time; against the architecture of Mansard, the interior decoration and other atrocities of that period of our history. Color is here, and—let us hope—to stay. Even mere man is today wearing neckties, socks and handkerchiefs that only a few years ago none but the hardiest of young bloods dared to display.

Color, judiciously applied has become the keynote of modern interior decoration, of glassware, china and pottery. Houses are built of multi-colored bricks, with roofs of an amazing variety of color. The use of color in the automobile industry is acknowledged as being one of the most powerful stimulants of sales ever adopted by an industry always on the alert for improvements and new sales appeal. A well-known make of portable typewriters, made especially for use in the home, is now being offered for sale in a variety of colors, to harmonize with home surroundings, and to please the individual taste of the prospective owner. Examples of this sort might be multiplied almost indefinitely.

The glass manufacturer, who in the past has stressed the importance of good design is turning more and more to the use of color, in order to give to articles in common use the added charm of coloration. Glassware, which upon careful inspection shows all the earmarks of mass production, can nevertheless be made a thing of beauty, and can become available through its low price to the purchaser of small means. Colored glassware, and ware with a beautiful luster is being offered for sale in five and ten cents stores.

To be able to create a new color which will find public favor is an accomplishment that may mean a change in prevailing taste, and is sure to result in increased profits to the manufacturer fortunate enough to originate it. Though others may imitate, the originator will have the cream of the market, while the late comers may be faced by another change in taste, just as they are getting down to mass production.

But, after all, the present taste for color may run its course, and disappear with the changes in fashion. However, there is another application of the use of color in the glass industry, yet in its infancy, which is not based on the whims of the moment, but on a solid, scientific foundation. It has been known for years that chemicals and pharmaceutical preparations must be protected from the action of light and heat rays, to prevent decomposition and chemical change. The study of the effect of radiations, received from the sun in the form of infra-red-, light-, and ultraviolet rays, on substances preserved in glass has had the attention of scien-

tists. But the results have not found their way to a practical application in the glass factory, except in a haphazard, rule-of-thumb manner. We have had with us in the past the brown, greenish and yellowish bottle for beverages, now forbidden. Everyone knows the blue-colored bottle of the pharmacist. Recent studies have shown that while these colors afford a certain protection against radiations of various wave-lengths, their selection has been made in a hit and miss fashion, not based on definite, scientific knowledge with regard to the absorption of rays, and their effect on the article in the container.

The present tremendous interest in ultraviolet transmitting glasses has brought to a focus the efforts of technical men and scientists to produce glass having definite properties with regard to a well-defined portion of the solar spectrum. It will follow, as a natural consequence, that there will arise a demand for the production of glass that will absorb—or transmit—other portions of the spectrum. In other words, the future holds promise of complete control of the effects of radiation of any wave-length.

Until a few years ago, the impression prevailed that only radiations of short wave-length, the "chemically active" rays, had to be excluded, to effectively protect pharmaceuticals, preserved foods, beverages, etc. Research work of later date has shown that other parts of the spectrum, easily transmitted through colored glass now in use, is absorbed by the materials which it is desired to preserve, and may cause chemical changes in them.

To the glass container industry, making a product that must be low-priced, the use of color may prove as important as it is at present to the manufacturer of ornamental glass and hollow ware. The flat glass industry is experiencing at this time one of its most interesting phases of development, through research work which has resulted in producing ultraviolet transmitting glasses. A similar field for expansion lies before the glass container and bottle industry, by making use of coloring materials, with the definite object to increase thereby the usefulness of their product to the consumer.

The price to pay will be confined practically to the expense of carrying on the necessary investigations. The cost of the coloring materials, needed to obtain the desired colors, is so small as to be negligible, in comparison to the increase in sales which is bound to follow the adoption of a well-defined, scientific policy with regard to the use of color, as an aid in preserving food and medicine.

Bulletin 441 "Productivity of Labor" Now Available

The Bureau of Labor Statistics, United States Department of Labor, has just issued Bulletin 441, a 212-page paper-bound volume on the "Productivity of Labor in the Glass Industry." Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at forty cents each.

This bulletin was prepared by Boris Stern, of the Bureau staff, after a thorough personal investigation completed last spring of conditions in the industry, and contains a large amount of valuable information on the cost of production of glass, including bottles and jars, pressed ware, blown ware, window glass and plate glass.

Part of this matter was reviewed in advance and at length in an article entitled, "Displacement of Labor by Machinery in the Glass Industry," which appeared in THIS JOURNAL, in two parts, in the May and July, 1927, issues.

In the completed bulletin now available all of the important methods of glass production are briefly described and the development of glass-making machinery traced. The effects of the tremendous industrial revolution brought about in the industry by semi-automatic and automatic machinery are shown.

Man-hour output and direct labor costs for the various kinds of ware are tabulated in elaborate detail. Statistics are given, for instance, of labor cost per box of window glass made on machines of cylinder type in 6, 8 and 12 machine units and on the Fourcault type, in 4, 6 and 8 machine units, for single and double strength glass. Wage rates are shown separately for each of the workmen's operations and their output under various conditions is tabulated.

Tables show the man-hour output and labor costs of casting rough plate glass by both the standard "discontinuous" process and the continuous process and by departments, such as casting, grinding and polishing, and cutting. Wages and labor costs per hour are given for each individual workman.

Eight tables, filling many pages, summarize the production and labor cost in bottle making, pressed ware, lamp chimneys, bulbs, tumblers, tubing, window and plate glass by hand and by machine.

No such comprehensive survey relating to production costs of the glass manufacturing industry as that given in this bulletin has been issued by the Government since 1917, when Miscellaneous Series Bulletin No. 60 was published by the Bureau of Foreign and Domestic Commerce of the Department of Commerce, giving the results of the investigation begun in January, 1916, under the authority of Congress.

Bureau of Standards Withdraws Circular on Ultraviolet Glasses

The following letter has been issued by the Bureau of Standards:

October 21, 1927.

Subject: Letter Circular 235, and first and second revisions. The ultraviolet spectral transmission of various new glasses and window glass substitutes, used in therapy.

The original and revisions including the second revision of September 29th, 1927, are withdrawn from circulation pending the analysis of new and important information on this subject.

There has apparently been confusion in interpretation of certain statements with regard to the comparative values of these new glasses for use in windows subject to incident sunlight and the interpretation of laboratory measurements on such glasses.

The bureau therefore desires the opportunity for further study of the matter, including sunlight tests.

Respectfully,

(Signed) GEORGE K. BURGESS, Director.

Ceramic Investigations at the Bureau of Standards

The National Bureau of Standards of the U. S. Department of Commerce has issued with the approval of the director, Dr. George K. Burgess, a 24-page multigraphed report on the Bureau's activities in the ceramic field during the past year.

The principal work in glass recorded in the report has been in connection with a study being carried on with the assistance of the Navy Department to determine the conditions affecting the quality of optical glass during melting, molding, and annealing.

During the past year five different kinds of glass were made as follows: borosilicate crown; light barium crown; barium flint; medium flint; and dense flint; the indices of refraction and dispersion being respectively, 1.517—64.0, 1.574—57.7, 1.605—43.3; 1.620—36.6, and 1.650—33.0. As a result of this work approximately 22,500 optical blanks of various shapes and sizes, weighing approximately 2,600 pounds, have been delivered to the Naval Optical Shop to be used as replacements and in the construction of new optical instruments.

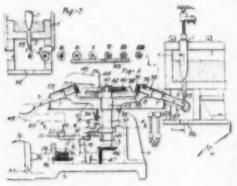
The production of relatively small pieces of good optical glass does not, in general, involve much difficulty, but large pieces are difficult to procure. Hence some trials to produce a large blank such as might be used for a reflecting telescope have been made. A circular cast iron annealing furnace 79 inches in diameter and 18 inches deep (inside) was lined with friable brick and about 800 pounds of molten glass poured into it. This furnace was surrounded by electrical resistance coils and well insulated with diatomaceous earth. Although the glass in this first test cracked, enough information was obtained to justify a second attempt in which approximately 3,500 pounds of glass was used.

Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

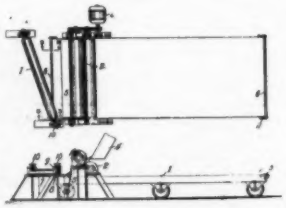
Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

MULTIPLE GLASS FEEDER. U. S. 1,647,746. Nov. 1, 1927. Karl E. Peiler, West Hartford, Conn., Assignor to Hartford-Empire Co. Filed 3/31/21. The method of feeding molten glass which comprises flowing the glass out of a container in an unsupported stream into a heated chamber, and winding the stream successively on a series of punties which are moved into and out of the chamber, then, when used for incandescent lamp bulbs, marvering the gather so obtained.



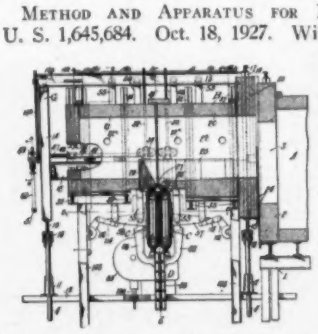
PERFUME BOTTLE. U. S. 1,647,175. Nov. 1, 1927. George Grunberg, New York, N. Y. Filed 10/16/26. A perfume bottle of clear glass having a flower therein indicative of the perfume, said flower being made also of glass and colored in simulation of the natural flower, said colored glass flower being supported in fixed relation in the bottle clear of the walls thereof by means of a glass stem in simulation of the stalk of such flower and integrally united with and forming a unitary extension of a portion of a wall of the bottle.

MANUFACTURE OF SHEET GLASS. U. S. 1,643,680. Sept. 27, 1927. Harold R. Schutz, Toledo, O., assignor to the Edward Ford Plate Glass Co. Filed 12/27/26. In combination, a conveyor for receiving sheet glass from a forming source and conveying it away from such source, a severing bar pivotally carried by said conveyor and adapted to be swung downwardly to inoperative position or disposed in usable position with its cutting edge projecting above the conveyor surface, means for releasably holding the bar in usable position, and means disposed above the conveyor and adapted to cooperate with said bar when in usable position to effect a severing of the sheet as the conveyor advances and while the sheet is in an unset condition.

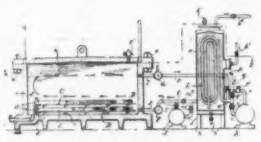


METHOD AND APPARATUS FOR WORKING QUARTZ. U. S. 1,645,086. Oct. 11, 1927. Edward R. Berry, Malden, and Philips K. Devers, Lynn, Mass. Assignors to General Electric Co. Filed 9/20/23. The method of converting a solid silica rod to tubing which consists in heating a portion of said rod to plasticity, forming a depression therein of materially lesser diameter than said rod, applying a gas under pressure to expand the softened portion into tubular form and then advancing the heating and expansion of said rod to an adjoining portion.

METHOD AND APPARATUS FOR MANUFACTURING GLASSWARE. U. S. 1,645,684. Oct. 18, 1927. William Emil Bock, Eagle Point Colony, O., Assignor to the Erie Glass Co. Filed 6/11/23. The method of making sheet glass, consisting in generating molten glass in sheet form a source of supply and passing the formed sheet downward, chilling strips of glass at spaced intervals crosswise of the sheet below stretching temperature, sustaining the weight of the sheet by contact with said cross-bars successively during the time that each cross-bar constitutes the uppermost bar in the sheet and releasing each bar at substantially the instant when another bar is chilled above it and before the glass between the bars is hardened beyond the stretching stage.

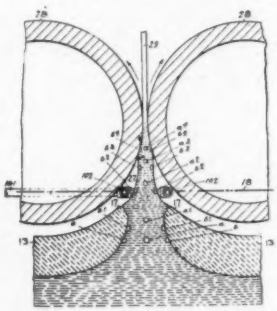


APPARATUS FOR MAKING LAMINATED GLASS. U. S. 1,645,580. Oct. 18, 1927. Edward S. Bock, Croydon, Ind. Filed 2/19/23. Means for circulating liquid in a heated condition and at different pressures during successive stages and within a closed chamber within which is positioned a hermetically sealed container for a plurality of glass sheets with an interposed layer of adhesive, whereby heated liquid may be circulated for a required period of time to render plastic said adhesive layer and subsequently thereto the liquid is circulated under pressure so as to so act upon the container and the contents thereof as to effect the union of the glass sheets by the plastic interposed layer.



GLASS-FORMING MACHINE. U. S. 1,642,828. Sept. 20, 1927. John F. Rule, Toledo, O., assignor to Owens Bottle Co. Filed 4/19/23. An object is to provide practical means for guiding charges of glass into the molds without interfering with the subsequent positioning and operation of the blow heads and without the necessity of withdrawing the guiding means. To this end, the invention in its preferred form comprises individual guides, each having a fixed position relative to the mold carriage and to its blank mold while the latter is in charge receiving position. The mold closure, or blow head, is designed to be brought downward past or through the guide into mold closing position without interference between said head and the guide.

METHODS OF AND APPARATUS FOR FORMING SHEET GLASS. U. S. 1,645,053. Oct. 11, 1927. George E. Howard, Butler, Pa., assignor to Hartford-Empire Co. Filed 2/6/26. A pair of rolls is provided for forming a sheet or plate from the glass which flows through the orifice, and for advancing the sheet or plate, preferably in a vertical direction. The lower faces of the rolls extend into the dished portion of the drawing ring or at least to a point below the orifice thereof, so as to engage the glass at a point close to the orifice. Also means for either cooling or heating the glass adjacent to its point of entry between the rolls, and for heating or cooling the sheet as it leaves the forming rolls, to avoid sagging, cracking or uneven bending.

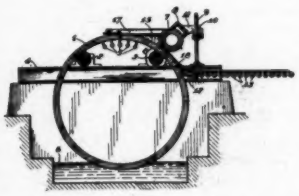


APPARATUS FOR PRODUCING MOLD CHARGES OF MOLTEN GLASS. U. S. 1,642,968. Sept. 20, 1927. William J. Miller, Swissvale, Pa. Assignor to Hartford-Empire Co. Filed 9/23/19. Comprises improvements in the shear mechanism employed to detach the masses of glass or mold charges discharged or extruded from the discharge port or outlet of the feeder.

GLASS-CUTTING MACHINE. U. S. 1,642,839. Sept. 20, 1927. Thomas H. Chadwick, Pittsburgh, Pa. Filed 4/11/25. It is proposed to provide traveling tables on which sheets of glass may be placed, and to provide means for moving the glass automatically beneath adjustable scoring devices, first in one direction and then in a direction at right angles to the first cut. Also means for continuously moving the tables in one direction and to provide in a single machine, a plurality of tables whereby the cutting

may be continuously and rapidly carried out. Also means for automatically removing the scored sheets from the tables, for removing chips of glass from the tables, and automatic means for controlling the movement of the tables so as to properly present the glass beneath the cutters in such manner as to effect the right angle scoring.

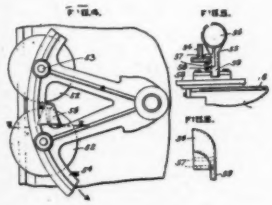
PROCESS OF MAKING SHEET GLASS. U. S. Re. 16,755. Oct. 4, 1927. Lee Showers, Charleroi, Pa., assignor to Pittsburgh Plate Glass Co. Filed 10/19/26.



A process of making a glass sheet, particularly adapted to thick colored glass, such as "Carrara" which consists in forming the sheet at a relatively high rate of speed from a body of molten glass, feeding the sheet into and partially through a lehr at the speed of its formation, and then feeding it onward through the lehr at a lower rate of speed. The process is designed to produce glass having a fire polished upper surface requiring no grinding and polishing and a lower surface which is substantially true and flat so that no grinding is required.

DECORATED GLASSWARE AND PROCESS. U. S. 1,647,362. Nov. 1, 1927. Robert S. Hughes, Beaver, Pa., Assignor to the Decal Products Co. Filed 1/21/27. A transparent glass plate or the like, having on the undersurface thereof a design of metallic color, and a backing for the design of vitreous enamel, the design and the enamel being fused together and to the body behind the display surface thereof, so that the design is viewed through a transparent surfacing to receive therefrom a lustrous or polished effect.

GLASS-POLISHING APPARATUS. U. S. 1,644,379. Oct. 4, 1927. Halbert K. Hitchcock, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 12/9/24.

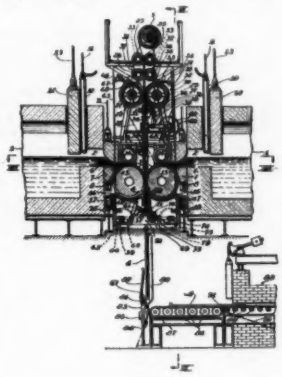


The combination with a series of runners mounted for rotation and each provided with an annular series of polishing blocks, means for driving the runners, and glass supporting means mounted for movement beneath the runners, of means for supplying a cooling flow of air downward upon the annular surfaces over which the runner blocks pass in their movement of rotation about the axes of the runners.

LEHR CONVEYER. U. S. 1,646,047. Oct. 18, 1927. Percy Q. Williams, Huntington, W. Va. Filed 6/3/22. The combination of a conveyer for bottles to be rolled on their sides, of a series of nozzles to direct blasts of air transversely of the conveyer, adjacent nozzles directing the air blasts in opposite directions whereby the air blasts may cool and roll the bottles.

GLASS-DRAWING APPARATUS. U. S. 1,643,184. Sept. 20, 1927. Arthur E. Spinasse, Mt. Vernon, O. Filed 9/9/26. The margin portions of the sheet frequently break off and fall down into the bath of molten glass and upon parts of the apparatus, doing injury to these parts and resulting in the drawing of imperfect glass. According to the invention rolls 25 and 26 are provided at a point to catch and divert the falling particles of glass into the catch pans 27 and 28 provided to receive same upon the furnace roof 5 adjacent the furnace opening 6. The rolls 25 and 26 are both urged yieldably against the glass sheet 7, and to this end such rolls may be carried by the depending arms 27 of the bell crank levers fulcrumed at 28 upon the lehr wall or other support and having the companion angularly projecting arms 29 provided with the adjustable weights 30 by which the pressure exerted by the rolls against the sheet and against one another through sheet may be regulated.

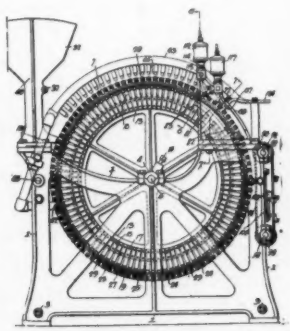
APPARATUS FOR MAKING REENFORCED GLASS TILE. U. S. 1,644,349. Oct. 4, 1927. William Owen, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 3/18/26. The sections of wire mesh are positioned in the glass sections with their ends short of the ends of such glass sections, so that the mesh is protected against rusting, which often occurs with wire reenforcing, beginning at the ends and working inward very considerable distances. Further objects of the invention are the provision of improved means for severing the wire mesh and the glass into sections, for shaping the ends of the glass sections thus severed and for handling sections.



METHOD AND APPARATUS FOR DRAWING SHEET GLASS. U. S. 1,647,403. Nov. 1, 1927. Enoch T. Ferngren, Toledo, O., Assignor to the Libbey-Owens Sheet Glass Co. Filed 10/29/24. A pair of members with their adjacent sheet-engaging faces slightly tilted with respect to each other are positioned directly above the sheet edge forming devices in such a manner that the plastic glass forming the sheet edge which is fed up by these devices, will be grasped between the pair of members and drawn upwardly and outwardly while still plastic.

DECORATED GLASS OBJECTS AND METHOD OF PROTECTING THE DECORATED SURFACES. U. S. 1,646,468. Oct. 25, 1927. Kalman Warga, New York, N. Y., Assignor to Pyrocolor Corp. Filed 4/2/24. The method of decorating glass objects and protecting the decoration which consists in printing the color design on the surface by decalcomania transfer, applying a coating of weather and acid-proof enamel over the color and then heating the glass to a temperature sufficient to fire the color, the material of the color and of the enamel having been previously so compounded as to fuse at a temperature below the fusing point of the glass.

MACHINE FOR SHAPING ENDS OF GLASS TUBES. U. S. 1,643,215. Sept. 20, 1927. Robert H. Koenig, Haddon Heights, N. J., assignor to Ruth Glass Co., Conshohocken, Pa. Filed 8/7/24.

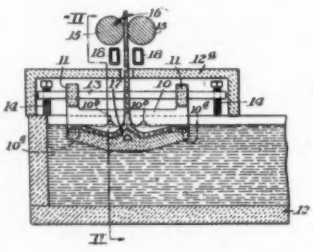


A machine comprising means for feeding the tubes or blanks continuously and successively through a series of operations involved in forming the vial. In this machine the various operations proceed continuously, the operating elements used in the final operation working upon one blank simultaneously with the elements employed in the preceding operations working upon the various succeeding blanks, so that there are no periods of idleness for any of the operating elements. As a result of this continuous and simultaneous operation the output of the machine per unit of time is considerably greater than that of machines in which each blank must be carried through all operations before a succeeding blank can be started.

METHOD FOR GRADING AND DELIVERING SAND TO GLASS-GRINDING MACHINES. N. S. 1,640,029. Aug. 23, 1927. James W. Cruikshank, Pittsburg, Pa., assignor to J. W. Cruikshank Engineering Co. Filed 5/5/22. In the method of grinding plate glass, the steps consisting of feeding coarse and medium coarse sand to the glass, continuously regrading this sand, and then feeding to the glass successive portions of a single continuous deposit containing a

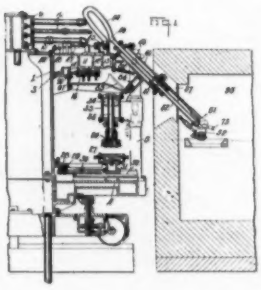
perfect sequence in a common horizontal plane of sand grains graded in accordance with the linear dimensions thereof.

METHOD OF AND APPARATUS FOR FORMING SHEET GLASS. U. S. 1,645,054. Oct. 11, 1927. George E. Howard, Butler, Pa., Assignor to Hartford-Empire Co. Filed 10/13/26. The method of forming sheet glass, which comprises flowing glass from a molten bath, to form a pool, drawing a sheet from said pool, cooling the glass adjacent to said pool to such an extent as would determine the thickness of a sheet drawn from an open bath at a given rate, and restricting the flow of glass from said bath to the pool to an amount less than required to form a sheet of said determined thickness.



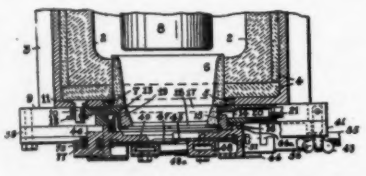
GLASS-FEEDING TROUGH. U. S. 1,647,541. Nov. 1, 1927. John Rau, Indianapolis, Ind., Assignor to Fairmount Glass Works. Filed 1/28/27. A feeder box associated with the plunger and spout of a glass feeding mechanism which secures the discharge of uniformly heated glass to and through the mouth of the spout to the mould, whereby the gob or gather has a symmetrical shape and is of a substantially uniform temperature and viscosity throughout, particularly when the gobs are of large volume for the making of large glass articles. A feature is a dividing block or partition in the feeder box such that a plurality of streams of glass are presented to the mouth of the spout in opposed relation, and said streams of glass are so arranged that the discharge to the mouth of the block follow diverging paths so as to encircle said mouth.

GATHERING MEANS FOR GLASS-WORKING APPARATUS. U. S. 1,645,755. Oct. 18, 1927. August Kadow, Toledo, O., Assignor to the Libbey Glass Manufacturing Company. Filed 9/1/22. A gathering unit including a ram, fluid controlled means for imparting reciprocatory movements to the ram, a gathering head movably carried by the ram and normally standing in one position of its movement relative thereto, and means dependent upon movement of the ram and automatically operable to move the head to a different predetermined position relative to the ram when the ram is at a predetermined point in its movement relative to the control means.

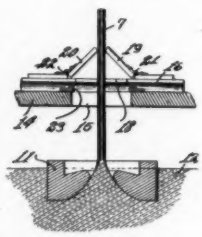


GLASS-BLOWING MACHINE. U. S. 1,647,532. Nov. 1, 1927. Edward H. Lorenz, West Hartford, Conn., Assignor to Hartford-Empire Co. Filed 9/1/22. An improved blowhead adapted to utilize compressed air from a single source of supply to produce different pressures for the blowing and holding down operations of the blowhead.

APPARATUS FOR PRODUCING MOLD CHARGES OF MOLTEN GLASS. U. S. 1,642,966. Sept. 20, 1927. Wm. J. Miller, Swissvale, Pa., assignor to Hartford-Empire Co. Filed 12/29/25. One of the features of the invention is a new and improved shear mechanism wherein the shear blades are mounted to slide toward and from each other. Others are: a new and improved character of shear blades, new and improved means for providing resilient pressure between the shear blades at the point of cutting. New and improved discharge outlet construction for the boot or shallow extension of the glass-melting tank or other container. New and improved combined blow-back and shear mechanism.

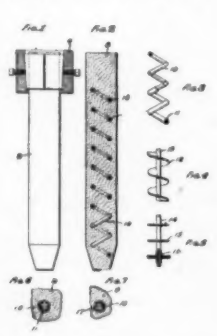


APPARATUS FOR DRAWING GLASS. U. S. 1,643,152. Sept. 20, 1927. Adhemar A. Debrocq, Fairchance, Pa. Filed 9/9/26. Frequently the edges or border portions of the drawn glass sheet break and the falling pieces of glass strike the Fourcault supplying float, denting or otherwise impairing the lips or edge portions of the slot through which the border portions of the sheet are drawn. The flaps 19 and 20 are loosely hinged to the plate provided with a slot through which the sheet of glass passes, and these flaps extend upwardly in angular relation to the plane of the plate 16 and they bear at their upper near edges upon opposite sides of the border portions of the sheet 7. Falling glass will strike the inclined flaps 19 and 20 and be deflected aside by them. The float 11 is thus protected from injury.

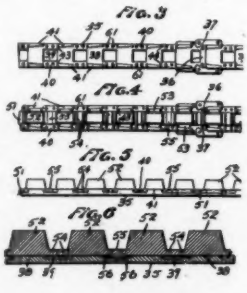


APPARATUS FOR FLATTENING SHEET GLASS. U. S. 1,641,918. Sept. 6, 1927. Elbridge J. Casselman, of Pittsburgh, Pa., and Nick Griffith and Charles E. Johnson, of Jeannette, Pa., assignors to the Window Glass Machine Co. Filed 8/16/26. Apparatus for flattening glass, comprising a chamber having therein a supporting body for the glass to be flattened, said body being of a glass-like character and having a higher silica content and melting point than the glass being worked on.

REINFORCED PLUNGER AND METHOD OF MAKING SAME. U. S. 1,635,439. July 12, 1927. Alexander L. Schram, Hillsboro, Ill., assignor to Ball Brothers Co. Filed 6/14/26. A plunger for glass furnaces which is reinforced in such a manner that the danger of the same breaking is materially lessened, and in such a manner that in the event of the plunger breaking, the parts will not separate and a portion thereof drop into the molten glass. The method consists in covering a metallic reinforcing member with a destructible coating of sufficient thickness to compensate for the expansion of said reinforcement when subjected to heat, surrounding said coated reinforcement with a body of plastic refractory material, drying said plunger thus formed, and lastly heating said plunger so as to destroy said coating.



RUNNER BAR FOR PLATE-GLASS-GRINDING MACHINES. U. S. 1,643,928. Sept. 27, 1927. Jacob Didion, Valley Park, Mo. Filed 10/10/24. A plurality of runner bar supports, each of which is provided with a series of spaced apart dove-tailed, wedge-shaped recesses located above one face of said bar, means for securing said runner bar supports to said disk, a plurality of runner bars, each of which is provided with a series of spaced apart projections, a wing formed integral with each side of said runner bars and located adjacent to and opposite each projection, the length of said wings being less than the distance between the adjacent dove-tailed, wedge-shaped recesses whereby said runner bar can be placed in position on or removed from said runner bar support without moving the same the full length of the runner bar support, and a locking plate located in the runner bar support for holding the runner bar in position.



FORMING SHEET GLASS FROM REMELTED CULLET. U. S. 1,646,488. Oct. 15, 1927. Thomas C. McKinley, Charleston, W. Va., Assignor to Libbey-Owens Sheet Glass Co. Filed 1/18/26. In preparing

glass for the Colburn machine it has been found that the quality of glass can be improved after it has started to run bad by adding a slightly higher percentage of cullet than originally. It has also been found that cullet which is not foreign cullet gives the most beneficial results. A process is here set forth wherein nothing but cullet is used to create a mass of molten glass from which the sheet may be drawn. The raw materials or batch is introduced into a furnace and subjected to heat. The molten glass then flows through the refining end and is permitted to overflow a lip upon an endless conveyor. A jet of cold water is brought to play upon the hot glass as it overflows the lip, which causes the glass to become solidified and broken up into cullet. Any form of tank can be used to produce the cullet. The cullet is then placed in a suitable receptacle having connection with a spout, so that at intervals the cullet may be discharged in the dog-house end of a tank furnace where it is again subjected to heat. The molten mass then flows through the refining end, cooling chamber, and out into the draw-pot, from which a sheet may be continuously drawn. By using this process, the amount of dust and dirt, which has heretofore been prevalent in the glass tank, is practically entirely eliminated.

New Edition of U. S. Patent Laws

The Patent Office has issued a reprint of the patent laws of the United States, edition of October 1, 1927. The volume includes information regarding the constitutional provision, organization of the Patent Office, patents, patent litigation, restraining trade, design patents, fees, inventions kept secret, index, and table of statutes and acts.

The Patent Office has a limited number of these reprints for free distribution.

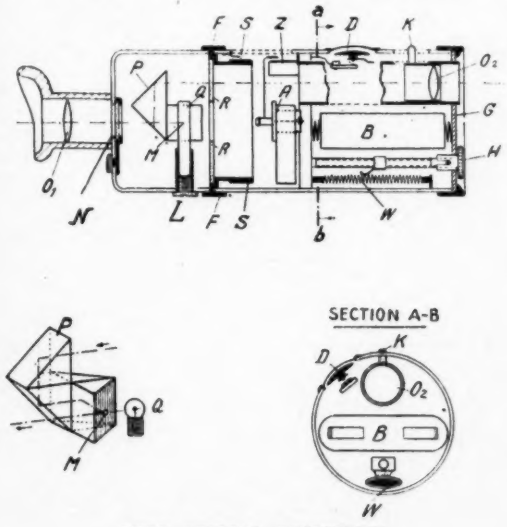
Glass Factory Equipment and Supplies

Most of the information printed in this department comes direct from the manufacturers of the products described.

A Simplified Optical Pyrometer

A new and simplified optical pyrometer, completely self-contained in compact form and which it is claimed will give accurate reading at a distance of 10 feet on a ¼-inch object, has been brought out by The Pyrometer Instrument Company, 74 Reade Street, New York.

The instrument is used like a telescope—it magnifies the object four times its actual size. The object itself appears in its actual colors. The light rays of the object to be measured are concentrated through the objective, shown as (02) on the diagram, in such a way that they are thrown on the plane M of the system of prisms (P) and are clearly seen through the eyepiece (01).



PYRO OPTICAL PYROMETER

The plane (M) of the prism has a small transparent test mark, which appears to the eye as a small, clear-cut elliptical ring. This ring is lighted by a tiny electric lamp (Q), by pressing the contact button D. The lamp receives current from a common dry-cell battery B of approximately 60 milliampere and can be adjusted by the rheostat W in connection with the milliammeter A.

This small elliptical ring in the range of vision, which at a distance of about forty feet covers an area of a nickel, represents the standard brightness, burning with constant intensity by which the light of the observed body is compared.

All to be done is to sight the instrument in such a way that the testmark covers the object to be measured, and to adjust the brightness of the range of vision until the testmark disappears. For this purpose, between 01 and P, a circular color filter has been inserted, with graduating density of color (R). This is rotated by the adjusting band F and filters the color of the object until the brightness of the testmark is matched. The temperature is then indicated on the scale S.

However, since all optical pyrometers work on monochromatic light after sighting, it is necessary to insert the red glass N by pushing the switch below the eyepiece, before measuring the temperature.

In order to get a clear picture, the eyepiece 01 can be adjusted by rotation. In case the distance is less than 6 feet, the objective 02 should be moved by the guiding button K, below the scale, so that the image falls within the testmark.

The battery B is a common dry-cell battery as used with flashlights. The use of this common type of battery has been made possible by developing a special micro lamp which requires but 60 MA. Everything has been so simplified that it takes only a few seconds to insert a new lamp by loosening screw L. All lamps are cemented into a small metal tube, fitted with a groove that assures the right position.

TAKING THE TEMPERATURE

At a distance of seven feet, the diameter of the range of vision is about eight inches. The angle of vision, therefore, is approximately 1:10, so that you can easily spot any object in the range of vision. At a distance of about 7 feet, the testmark covers an area of about one-eighth inch. This shows that objects of minute size can easily be measured. This is an achievement attained it is asserted by no other pyrometer.

The Glass World and What It Is Doing

News of the Industry

Glass Container Meeting at Pittsburgh

At the meetings of the Glass Container Association held at Pittsburgh during the progress of the "See What you Buy—Buy in Glass" drive late in October, President Ferguson made a forceful address on the Association and its activities. In the course of his talk, referring to association officers, he said:

"Unless they are properly supported they are like a one-armed man. Before a one-armed man can clap hands he needs aid; he not only needs someone to supply the second hand, but that someone must be responsive to the same emotion, the same enthusiasm, the same impulse at exactly the same moment, to make the work effective. Complete accord is needed for true co-operation.

"One of the difficulties connected with trade association work is lack of continuous and responsive interest on the part of the membership.

"Paying our dues promptly does not make a good member of us. We may adopt a code of ethics, but unless lived up to this code means nothing."

He also stated that the association is functioning as well as any association he knows of, but that is not enough, and he urged better team work, better understanding and closer co-operation, deeper interest and more activity so that more progress may be made.

Dr. Herbert Pease, president of the Pease Laboratory, spoke on "Research and Industry."

Reports were received from C. H. Werner, chairman of the research committee, and J. C. Magness, traffic manager. Mr. Magness reported that some delay would occur in the effective date of the new rates on glass containers, carload, in Official territory, owing to the fact that the railroads had encountered an obstacle to the immediate publication of the rates in the form of fourth section violations which it was found necessary to submit to the Interstate Commerce Commission for the requested relief.

He also discussed the situation as to sand rates, pointing out that an early decision was expected from the Commission in important cases and that the decision would have a controlling effect upon the level of sand rates throughout Official territory. He advised against making new complaints on sand as tending to delay reductions which would arise from decisions in cases now before the Commission.

Mr. Grimes of the Bureau of Internal Revenue spoke on "Standard Depreciation Rates."

J. S. Algeo, chairman of the statistical committee, E. G. Ackerman, cost accountant, Fred J. Rummel, statistical director all made reports.

J. P. Brunt, president of the Paperboard Industry Association spoke on "Association Activities."

On Friday morning, Dr. Sumner Ely, professor of mechanical engineering, Carnegie Institute and secretary of the International Conference on Fuel, spoke on "Fuels." He enumerated the different sources of power that had been and is now being used and showed that coal was the only source known that could be depended upon for any number of years. He referred to the conservation work being done in the fuel industry.

J. P. Thomy, president of the Best-Clymer Company, gave an address on "How the Glass Man and the Preserver Can Co-Operate."

E. O. Hiller of the Hartford-Empire Company read a very interesting paper on the "Annealing of Glass" and by means of a polariscope showed the strains of varying degrees in simple glasses and showed how they were classified in connection with the work of his company.

On Friday afternoon, I. R. Stewart, chairman of the publicity committee, made a report on the Pittsburgh campaign and made plans for further work which has been approved by the Board of Directors.

The Publicity Committee has since recommended that the Board of Directors authorize a similar campaign in New York City.

American Refractories Institute Meeting

The joint meeting of the American Refractories Institute and American Institute of Chemical Engineers will open December 6 at Chase Hotel, St. Louis. Dr. E. R. Weidlein, director of Mellon Institute, is the president of the American Institute of Chemical Engineers, and J. M. McKinley, vice-president and general manager of the Crescent Refractories Company, is president of the American Refractories Institute. Both of them will address the members.

The program will include a motion picture, "The Story of Fire Clay Refractories"; addresses on "The History and Status of the Refractories Industry," by J. D. Ramsay, president, Elk Fire Brick Company; "Problems in the Development and Technology of Refractories," by Stuart M. Phelps, Mellon Institute; "Some Special Refractories," by Prof G. A. Bole, Ohio State University; "Developments in Burned Dolomite as a Stable Basic Refractory," by M. E. Holmes and G. A. Bole. Prof. R. K. Hursh will discuss "A Laboratory Furnace for Testing Slag Resistance of Refractories." German Laboratory practice will be described and illustrated by slides, by A. P. Green.

On Wednesday, December 7, an open-forum session will be held. A symposium will be conducted for the discussion of problems primarily of interest to the chemical industry. Papers will be presented by nationally prominent chemical engineers, who are considered authorities in their field.

Building Construction Conditions

New construction started in the 37 eastern states (about 91% of the total in the United States) in October reached a total of $562,815,800, according to F. W. Dodge Corporation. The above figure was the highest October contract total on record and was the fourth largest monthly total on record for this year. It was 8 per cent ahead of the September, 1927, figure and 9 per cent over the total for October of last year.

September construction contracts in the 37 states east of the Rocky Mountains amounted to $521,611,000, according to F. W. Dodge Corporation. This amount was 6 per cent under August, and 7 per cent below the total for September of last year. Construction in these 37 states includes about 91 per cent of the total in the United States. New construction started in the 37 Eastern States during the first nine months of this year has amounted to $4,796,482,100; compared with the total for the same period of last year ($4,840,779,800), this figure shows a decline of less than 1 per cent.

Window Glass Prices Again Reduced

American Window Glass Company on November 15th notified the trade of a reduction in prices. The following discounts, therefore, are now in effect on all orders for A and B qualities, single and double strength flat window glass, carload lots, all zones.

B quality, single strength, first bracket 91 per cent.
B quality, single strength, above bracket, 90 per cent.
B quality, double, all brackets, 90 per cent.

For all A quality single strength and double strength the prices will be two points higher than for B quality. At the above discounts for A quality there will be no increase in charge for paper packing. The above discounts are from the list of October 15, 1912. No guarantee against the company's own declines in prices or reductions by competitors will be given.

Butterworth Bros., Ltd., Extend Their Activities

In a recent communication Mr. L. Milner Butterworth, director, Butterworth Bros., Ltd., stated that on November 12 a new works canteen was opened at the Manchester, England, plant by R. Carrington Walthew, M.Sc., A. I. C., formerly of the Special Brigade of the Royal Engineers. The day was chosen in

order that the event might fall as near as possible to the ninth anniversary of the Armistice.

Upon his arrival Mr. Walthew was conducted over the plant, which produces both glass for industrial purposes and fine tableware. At the canteen premises he was welcomed by the chairman and secretary of the Canteen Committee, which consists of representatives from each of the works departments. The canteen occupies two floors and is equipped on the most modern lines.

Glass Division Program at Atlantic City

Members of the Glass Division, American Ceramic Society, have been informed by C. D. Spencer, chairman of the committee on papers and program that the committee will endeavor to present at the Atlantic City meeting, next February, a résumé of the work of a number of the famous men closely associated with the development of the glass industry. Scientists and industrialists are included in this list. "Mr. Walbridge, of the Owens Bottle Company, will present through Mr. Morrison a paper on the life and work of E. D. Libbey and Mike Owens. Mr. Oswald will tell you about Commodore Richardson, and Dr. E. W. Washburn, of the Bureau of Standards, will present to you a paper on the researches in connection with glass making of that incomparable experimenter, Michael Faraday." The list of papers to be presented will include the following:

(4) "Glass Manufacturing in Brazil," by H. Haynes.

(5) "Glass Industry in Japan," by K. Fuwa.

(6) "Determination of Iron in Glass Sand," by G. E. F. Lundell.

(7) "Experiments Concerning a New Method for the Production of Refractories for the Metal and Glass Industries," by H. Miller.

(8) "Some Electrical Properties of Glasses Used for the Manufacture of Electric Lighting and Discharge Devices," by H. Miller.

The program committee has a promise of a paper from Prof. W. E. S. Turner, and is now endeavoring to obtain a number of papers on the various aspects of the new ultraviolet transmitting glasses.

Issue New Edition of Chemical Engineering Catalog

The twelfth annual edition of Chemical Engineering Catalog has been issued by The Chemical Catalog Company, Inc., 419 Fourth Avenue, New York. This publication, in its twelve years of useful service to 25 or more chemical and chemically controlled industries, has grown to the point where the 1927 edition contains the listings of products of more than 2,000 manufacturers. The volume contains 1,160 pages, 8½ by 11 inches in size. A flexible leather binding of first class quality makes the handling of the book easy and adds to its handsome appearance.

Nearly 300 pages are devoted to classified listings of manufacturers' and producers' products, about 800 to descriptions and specifications of those products, and about 50 to lists of technical books.

The volumes are distributed by the publishers free to those engaged as chemical engineers, works executives, consulting, designing and constructing engineers, chief chemists of industrial and research laboratories, heads of chemical engineering departments in universities, colleges and technical schools and to technical departments of the United States and foreign governments and libraries, on condition that the recipient returns the copy on publication of the next succeeding issue; or it will be sent to persons included in the above classification, with the privilege of retaining possession permanently, for $3.00, mail or express charges prepaid. To others a charge of $10.00 a copy is made.

Plate Glass Production

The production of polished plate glass for the month of October, 1927, according to figures compiled by P. A. Hughes, secretary of the Plate Glass Manufacturers of America, was 8,703,214 square feet as compared with 9,353,197 square feet produced in the previous month, September. The production for October, 1926, was 11,185,713 square feet.

The total for the third quarter (October not included) was 28,837,600 square feet, as compared with 27,916,457 square feet produced in the second quarter. The total production for the third quarter of 1927 was 4,615,898 square feet less than the production for the corresponding quarter in 1926, which amounted to 33,453,498 square feet.

Damaged by Gas Tank Explosion

The plant of the Pittsburgh Clay Pot Company located on the lower North Side of Pittsburgh and adjoining the works of the Equitable Gas Company, which were demolished when a large gas tank exploded on November 14, was badly damaged. The plant of the Rosedale Foundry & Machine Company, makers of glass machinery castings, in the same neighborhood was slightly damaged. Two of the Standard Plate Glass Company's warehouses were also damaged to some extent.

Glass Sand Production in 1926

The production of glass sand sold or used by producers in 1926, and a comparison with the previous year has been compiled by the Bureau of Mines, Department of Commerce, Washington, D. C., along with that of molding, building and other sands. For glassmaking in 1926 2,274,218 short tons valued at $3,615,371 were produced, compared with 2,334,921 short tons valued at $3,836,085 in 1925. Sand used in various industries for grinding and polishing was produced to the amount of 1,859,215 short tons valued at $2,504,514. The amount produced was slightly less than that of 1925 and the total value was slightly higher.

Northwood Company's Old Plant Sold

The manufacturing plant at Wheeling, W. Va., formerly operated by the H. Northwood Company as manufacturers of glassware and glass novelties, has been purchased by the J. R. Greenlee Company of Bellaire, O., who have been engaged since 1906 in the wholesaling and retailing of glass, paints, wall paper, etc., having started at that time in a small way. Local reports state that J. W. Fenton will be general manager in charge of manufacturing operations. The old Northwood plant will be remodeled and new molds and processes for colored and decorated ware developed. Operations will begin as early as possible.

Pittsburgh Plate Glass Will Build California Plant

The Pittsburgh Plate Glass Company, has announced its decision to build somewhere in the vicinity of Los Angeles a large new polished plate glass manufacturing works, with the object of putting the company in a position to serve the Pacific Coast and export market more effectively.

J. A. Bechtel, the company's purchasing agent who had made a six weeks' investigation of manufacturing costs and distributing facilities in that territory and obtained options on suitable factory sites returned to Pittsburgh shortly before the news was given out. The plant will probably cost several million dollars and employ about 500 workmen.

American Ceramic Society Annual Meeting

The American Ceramic Society thirtieth annual meeting will be held at the Hotel Ambassador, Atlantic City, February 5 to 11. This will be a joint meeting of the National Brick Manufacturers' Association and the Heavy Clay Products Division.

The nominating committees have reported the following nominations: For president, M. C. Booze and J. C. Hostetter; vice-president, R. R. Danielson and M. F. Beecher; treasurer, H. B. Henderson. Self-appointed committees of ten have the privilege until December 14 of placing others in nomination.

Fostoria Glass Company Plans New Factory

Unofficial reports from Moundsville, W. Va., state that the Fostoria Glass Company is obtaining bids for the construction of a new factory in which $100,000 will be invested. It is said that the new building will include furnaces and finishing department and will be a complete plant in itself, but will be operated in conjunction with the present plant. It is also stated that the project has not been approved by the board of directors but that an announcement concerning it will be made within a few weeks.

Trade Activities

The Michigan Alkali Company has moved its Chicago office from 332 South Michigan Avenue to 1316 South Canal Street, Canal Station.

The Interstate Window Glass Corporation of Pittsburgh is reported to have purchased the property of the Interstate Window Glass Company at Clarksburg, W. Va.

The Whitall-Tatum Company, George S. Bacon, general manager, Millville, N. J., recently completed a new glass making unit and operations were started about the middle of October.

The Wickwire Spencer Steel Company, New York, one of whose specialties is woven wire lehr belts, will continue to operate under the receivership of C. Bowers and C. L. Feldman.

The General Flat Glass Company, Mannington, W. Va., after operating for a short time are reported to have shut down their plant late in October for minor alterations and cold repairs.

The Tiffin Cut Glass Company was recently incorporated at Tiffin, O., with a capital of $10,000 by Herman Hoerig, Joseph L. Grieselding, Floyd Johnson, Francis G. Drummer and Otto P. Schulz.

L. J. Houze Convex Glass Company, Point Marion, Pa., is reported to have suffered a loss of about $25,000 when fire damaged the grinding and polishing room, but did not reach the main factory 200 feet away.

The Sheffield Glass Bottle Company's plants at Sheffield and Wilcox, Pa., may be sold, if plans for the transaction are approved by the creditors, in which case the sale will probably be held during December.

The Adamston Flat Glass Company, Clarksburg, W. Va., has appointed G. D. Seigel as special sales representative for their heavy glass from 3/16 inches up, with offices at 640 West 44th Street, New York.

The Angelus Glass Company, Los Angeles, Cal., recently chartered with a capital of $100,000 will engage in the glass jobbing business. C. H. Hawkins and J. C. Campbell, both of Los Angeles, are interested.

The Sunset Glass Company of California, Inc., was recently organized at Los Angeles, Cal., with a capital of $200,000. The incorporators include F. M. Smith, E. C. Fox and others. The company will manufacture and deal in glass products.

Kelly & Steinman, Inc., cut glass manufacturers, have been placed in bankruptcy and George J. H. Crowe of Binghamton, N. Y., has been appointed receiver in an order issued by the Federal Court of Utica, N. Y. on a petition made by creditors.

A strike of several hundred employes at the **Standard Plate Glass Company,** Butler, Pa., following a reduction in wages estimated as amounting to 10 to 15 per cent was started on November 16. Up to the time of going to press with this issue the strike was still in force.

The Standard Plate Glass Company's statement for the quarter ended September 30, 1927 showed a net loss for that period of $87,586.

The American Ornamental Bottle Company, Lynchburg, Va., has been incorporated in that state with a capital of $100,000 to manufacture fancy and decorated bottles and containers. Two incorporators are: E. H. Hancock, F. Harper.

The American Window Glass Company's statement for the year ended August 31, 1927 reported a net profit of $817,351, compared with $1,237,356 the previous year. Surplus after payment of dividends amounted to $165,911, compared with the surplus on August 31, 1926, of $228,474.

Net earnings of the **Hazel-Atlas Glass Company** for the quarter ending September 30, 1927 showed a gain of 18 per cent over the same quarter of 1926. The company's surplus, after paying dividends, for the first nine months of 1927 amounted to $1,353,336. The dividends saved by the recent absorption of Libbey-Owens' stock holdings have been applied to increasing dividends on outstanding shares to 62½ cents.

Octave Jacqmain, who has for several years been connected with the Libbey-Owens Sheet Glass Company, Charleston, W. Va., is now with the Pittsburgh Plate Glass Company and reported to be in charge of window glass manufacturing operations.

H. C. Ganter, who has been in charge of the Atlantic Bottle Company's plant at Breckenridge, Pa., for a number of years, has resigned from that organization. He plans to continue his activities in the bottle field by making a connection with some other large bottle manufacturer.

Pennsylvania Wire Glass Company has made an offer which has been accepted by the Chamber of Commerce of Lewistown, Pa., for the use of a field owned by the company in the Hollywood section, as an emergency landing field for airplanes.

The Knox Glass Bottle Company, Knox, Pa., was compelled to shut down its plant early in November on account of a break in the tank. Repairs were begun immediately with the purpose of resuming manufacturing operations as early as possible.

The Mathieson Alkali Works, Inc., 250 Park Avenue, New York, announces that F. H. Lovenberg, formerly in charge of the St. Louis district sales territory, has been assigned to the New England district sales office, Providence, R. I., to replace C. J. Clegg, who recently resigned.

The Acme Art Glass Company, has been incorporated at Pittsburgh, Pa., to manufacture, buy, sell and deal in art, plate and window glass and articles of merchandise composed wholly or partially of glass. The incorporators are: Joseph L. Wiltman, John Wiltman, A. Wiltman and M. Wiltman.

L. Solomon & Son, Inc., 199 Wooster Street, New York, announce that Frank D. Fowler, formerly manager of the Benjamin Griffen Glass Corporation at New York, has joined their organization as manager of the window, picture glass and rough rolled departments.

Herbert A. Johnson has been appointed New York manager of the Leipzig Trade Fair, Inc., at 630 Fifth Avenue, New York, to succeed the late E. A. Boettcher. The dates of the next fairs, to be held at Leipzig, Germany, are: General fair, March 4 to 10, 1928; Technical fair, March 4 to 14, 1928.

The Morgantown Flat Glass Company, Morgantown, W. Va., purchaser of the old U. S. Window Glass Company plant in that city, is reported to have announced on October 28, through Attorney James R. Moreland, a director of the new corporation, the issuance of $350,000 first preferred stock. The new capital, it is said, is wanted for the purpose of resuming operations at the plant.

Owens Bottle Company and its subsidiaries for nine months ending September, 1927 showed a net profit of $4,004,910, after deducting expenses and federal taxes, equivalent after allowing for dividend requirements on 39,500 outstanding shares of 7% preferred stock to $5.21 a share (par $25) earned on 728,853 shares of common stock. This compares with $4,889,270, or $6.43 a share, on 694,098 shares outstanding in first nine months of 1926.

The Osaka Municipal Office of the Department of Commerce and Industry has issued a 64-page, 1927, directory of exporters and importers of Osaka, Japan, giving the name of the concern, address and character of products in which they deal. Included are those importing and exporting table and other glass ware, shades, globes, bottles, beads, bangles, also plate glass, tubing, etc. Firms interested are requested to send to the department their catalogs, price lists, etc.

The Pennsylvania Glass Sand Corporation, Lewistown, Pa., exploded what is said to have been the largest charge of dynamite of the kind ever fired in the State at its Mapleton, Pa., quarries. The charge is said to have been blasted in a tunnel 65 feet long drilled into the face of solid rock, with laterals 75 feet in length running out from each side. These were loaded with 35,000 pounds of 6% dynamite. The blast was reported to have been remarkably successful and it is estimated that 300,000 tons of silica sand rock were loosened to be quarried and prepared for use in glass making.

The Pine Glass Corporation, Okmulgee, Okla., according to reports from that city have let contracts for a concrete and steel factory together with warehouse, 350 by 750 feet. Also a cap factory, 75 by 250 feet. A daily output of five to six carloads of fruit jars and wide mouth ware has been planned for. The report states that contracts have been awarded to the Miller Machine & Mold Works, Columbus, O., for glass machinery and to the Amsler-Morton Company, Pittsburgh, Pa., for annealing equipment.

Industrial Publications

Laboratory Apparatus. Central Scientific Company, 460 East Ohio Street, Chicago, Ill. Catalog C-227, 7½ x 10¾ inches, 780 pages. Bound in stiff buckram covers. Devoted to Laboratory Apparatus of all kinds for chemical, industrial, metallurgical, bacteriological, biological, Board of Health, clinical, hospital and commercial testing laboratories. Some idea of the size and completeness of this publication may be formed when it is known that the index alone occupies 24 pages at the back of the book and comprises some 7,000 items. Practically all kinds of materials, supplies, apparatus and equipment used in laboratories is listed and many described in detail. The Central Scientific Company was established in 1889 and incorporated in 1900.

High Temperature Insulation. A 16-page pamphlet giving a lecture on High Temperature Insulation, compiled by the Celite Products Company, Los Angeles, Cal. This lecture is being used by about fifty of the leading engineering schools throughout the country. It includes data on methods of measuring heat flow through walls, as well as temperature gradients and heat losses through typical insulated and uninsulated walls. Drawings are included showing methods of insulating various types of high temperature equipment, such as boilers, furnaces, blast furnace stacks, open-hearth regenerators and flues, etc. Printed copies have been made for the permanent records of the students before whom the lecture is given and a limited quantity will be available for others interested in the subject.

Recent Deaths

Daniel A. Ripley

Daniel A. Ripley, superintendent of the H. C. Fry Glass Company, Rochester, Pa., died on November 18 in that city after a short illness.

Mrs. Ann Miller

Mrs. Ann Miller, mother of the well known machinery manufacturers, Edward Miller of Columbus, O., and William J. Miller of Swissville, Pa., who was struck by an automobile last April, died on October 22 at the age of 90 at the Tiffin, Ohio, home of her daughter. Three other sons Ferdinand, Leo and Victor J., and the daughter, Mrs. F. G. Keller, also survive.

Coming Meetings

The American Ceramic Society annual meeting will be held at the Ambassador Hotel, Atlantic City, N. J., February 5 to 11, 1928. This will be a joint meeting of the National Brick Manufacturers Association and Heavy Clay Products Division. The European tour of Society will cover the period from May 19 to July 5, 1928, and will include visits to England, Germany, Czechoslovakia, France, Holland.

The National Glass Distributors Association will hold its thirteenth annual meeting at the Hotel William Penn, Pittsburgh, December 6 and 7. The **Mirror Manufacturers** will attend a conference at Pittsburgh called for at the same time.

The American Refractories Institute winter meeting will be held in conjunction with the American Institute of Chemical Engineers at the Chase Hotel, St. Louis, Mo., on December 6.

The Sixth Annual Exposition of Power and Engineering will be held at the Grand Central Palace, New York, December 5 to 10.

Inquiries Received

For further information address the GLASS INDUSTRY

392. Our client wishes to obtain the addresses of American firms which can furnish roller lehrs for glass plates. (Nov. 5)

393. Can you secure for us the names of the manufacturers of ultraviolet glasses known as Vioray and Bretlet? (Nov. 11)

394. I am interested in securing a glass engraving lathe. (E. J. Huber, 40 Caine St., Battle Creek, Mich.). (Nov. 10)

395. We understand there is a machine for the automatic production of bottles from small size up to about one pint which is used for making limited quantities.

What the World Wants

Specific Inquiries for American Goods, Received in the Department of Commerce, Washington, D. C.

German: 28,278, electric light bulb manufacturing machinery.
East Africa: 28,233, soda bottles.
China: 28,235, broken glass.

Glass Stock Quotations

PITTSBURGH STOCK EXCHANGE, NOVEMBER 22, 1927
Reported by Moore, Leonard & Lynch, Union Trust Bldg., Pittsburgh, Pa.

	Bid	Asked	Last
American Window Glass Machine, com..	18	20	19
American Window Glass Machine, pfd....	..	50	51
American Window Glass, pfd.....	..	94	90
United States Glass	16	17½	16
Pittsburgh Plate Glass, com.....	210	..	212
Standard Plate Glass, com.....	2	2½	2 1/16
Standard Plate Glass:			
Preferred cumulative	..	..	105⅛
Prior preferred	25	..	33

TOLEDO, O., NOVEMBER 21, 1927

	Bid	Asked	Last
Owens Bottle, pfd.	116½	118	118
Libbey-Owens Sheet Glass, com.....	119	123	121
Libbey-Owens Sheet Glass, pfd.....	115½	...	114

WHEELING STOCK EXCHANGE, NOVEMBER 21, 1927

	Bid	Asked	Last
Hazel-Atlas	73	73½	73½
Imperial	...	...	72
Fostoria	200	...	208
Central	...	...	75
Jefferson, pfd.	...	...	96

READERS WANTS AND OFFERS

Shift Foremen—We require immediately two first-class upkeep men to act as shift foremen. Must be familiar with Lynch machines and capable of making all repairs. Knowledge of feeder operation essential. LOCATION—Southern California. No transportation furnished. Write fully giving reference, wages expected and your qualifications. Steady work for right party if you can get results. A-2, % THE GLASS INDUSTRY, 50 Church Street, New York.

For Sale: CULLET of all Descriptions
Free from Caps, Wires, etc.
GEORGE F. BAUMANN, Dealer,
1110 Carroll Street, Brooklyn, New York.
Carloads Ready for Immediate Shipment.

For Sale: Journal of the Society of Glass Technology. December, 1919; March and December, 1923. Complete sets of 1920, 1921 and 1922. Price (unbound) $22.00. Address Box P, care THE GLASS INDUSTRY, 50 Church Street, New York.

Current Prices of Glass-Making Materials

November 21, 1927

Quotations furnished by various producers, manufacturers and dealers.

		Carlots	Less Carlots
Acid			
Citric (dom.)	lb.	.44½	.44½
Hydrochloric (HCl) 20° tanks, per 100	lb.	..	1.05-1.10
Hydrofluoric (HF) 60% (lead carboy)	lb.	..	.13½
52% and 48%	lb.	.10	.10-.11½
Nitric (HNO_3) 38° carboy ext. Per 100	lb.	5.50	5.75
Sulphuric (H_2SO_4) 66° tank cars	ton	15.00-16.00	..
Tartaric	lb.	.34-.36	.36
Alcohol, denatured	gal.	..	.48½
Aluminum hydrate (Al $(OH)_3$)	lb.	.04½-.05	.05½-.06
Aluminum oxide (Al_2O_3)	lb	..	.07
Ammonium bifluoride (NH_4) FHF	lb.	..	.19-.21
Ammonia water (NH_4OH) 26° drums	lb.	.02½	.02¾
Antimony, metallic (Sb)	lb.	..	.10¾-.10½
Antimony oxide (Sb_2O_3)	lb.	..	.14-.16
Antimony sulphide (Sb_2S_3)	lb.	.15	.16
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.04	.04¼-.04½
Barium carbonate ($BaCO_3$)			
Precipitated	ton	53.00	58.00
Natural, powdered, imported	ton	48.00	50.00
Barium hydrate ($Ba(OH)_2$)	lb.	..	..
Barium nitrate ($Ba(NO_3)_2$)	lb.	.08¼	.08½
Barium selenite ($BaSeO_3$)	lb.	..	..
Bone ash	lb.	.05	.05½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	.03¾	.04-.04½
Boric acid (H_3BO_3)	lb.	.08-.08¼	.08¼-.09
Refined	lb.	.08-.08¼	.08½-.08¾
Cadmium sulphide (CdS)—			
Red	lb.	..	1.20
Orange	lb.	..	1.10-1.25
Yellow	lb.	..	1.20-1.40
Chromium oxide (Cr_2O_3)	lb.	.27	.28
Cobalt oxide (Co_2O_3)			
In bbls.	lb.	..	2.10
In 10 lb. tins	lb.	..	2.20
Copper oxide			
Red (Cu_2O)	lb.	..	.30
Black (CuO)	lb.	..	.25-.30
Black prepared	lb.	..	.30
Cryolite ($Na_3Al F_6$) Natural Greenland Kryolith)	lb.	.09	.10-.10½
Artificial or Chemical	lb.	.	.09½
Epsom salts ($MgSO_4$) (imported) Per 100	lb.	..	1.15-1.30
Feldspar—			
100 mesh	ton	11.00-20.00	15.50-22.00
80 mesh	ton	..	14.50
40 mesh	ton	12.50	13.50
Fluorspar (CaF_2) domestic, ground, 95-98% (max SiO_2 2½%)			
Bulk, carloads, f.o.b. mines	ton	32.50	..
In bags or barrels	ton	36.50	41.50
Formaldehyde	lb.	.08½	.09
Graphite (C)	lb.	..	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb.	..	.04½-.07
Black (FeO)	lb.	.03½	..
Kaolin (f.o.b. mine)	ton	9.00	..
English, lump, f.o.b. New York	ton	13.00-23.00	..
Kryolith (see Cryolite)			
Lead chromate ($PbCrO_4$)	lb.	..	..
Lead oxide (Pb_3O_4) (red lead)	lb.	.09¾	.09¾-.10
Litharge (PbO)	lb.	.08¾	.08¾-.09
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	12.50	..
Burnt (CaO) ground, in bulk	ton	9.00	..
Burnt, ground, in paper sacks	ton	11.00	..
Burnt, ground, in 280 lb. bbls.	Per bbl.	2.15	2.30
Limestone ($CaCO_3$)		2.00	..
Magnesia (MgO)—			
Calcined, heavy (in bbls.)	lb.	.05-.06	.07
light (in bbls.)	lb.	..	.23
extra light (in bbls.)	lb.	..	.37
Magnesium carbonate ($MgCO_3$)	lb.	.06	.07½-.08
Manganese 85% (MnO_2)	lb.	.04	.04½
Nickel oxide (Ni_2O_3), black— for nickel content	lb.	..	.35
Nickel monoxide (NiO), green— for nickel content	lb.	..	.35
Plaster of Paris, bags	ton	..	23.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb.	.08¼	.08½
Ground	lb.	.11	.12
Potassium carbonate—			
Calcined (K_2CO_3) 96-98%	lb.	.06⅝	.07⅛
Hydrated 80-85%	lb.	.06	.06½
Potassium chromate (K_2CrO_4)	lb.	..	.28
Potassium hydrate (KOH) (caustic potash)	lb.	.07⅛	.08
Potassium nitrate (KNO_3) (gran.)	lb.	..	.05⅞-.06
Potassium permanganate ($KMnO_4$)	lb.	.15	.15½
Powdered blue	lb.	..	.24-.26
Rochelle salts, bbls.	lb.	..	.23
Rouge	lb.	..	..
Rutile (TiO_2) powdered, 95%	lb.	.15-.20	.20-.25
Salt cake, glassmakers (Na_2SO_4)	ton	22.00	..
Selenium (Se)	lb.	..	2.10-2.15
Silver nitrate ($AgNO_3$)	oz.	..	.40¼-.42
Soda ash (Na_2CO_3) dense, 58%—			
Bulk, on contract	Flat per 100 lb.	1.22½	..
In barrels	Per 100 lb.	1.55-1.57½	2.40
In bags	Per 100 lb.	1.37½	..
Spot orders .05 per 100 lbs. higher			
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.06¼	.06⅜
Sodium hydrate (NaOH) (caustic soda)	Per 100 lb.	3.50	..
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	lb.	.03¾	.04
95 per cent.	Per 100 lb.	2.45	2.80
Sodium selenite (Na_2SeO_3)	lb.	..	2.35
Sodium fluosilicate (Na_2SiF_6)	lb.	.05	.05½-.06
Sodium uranate (Na_2UO_4) Yellow or Orange	lb.	..	1.25
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb.	3.45	3.80-4.00
Flowers, in bags	Per 100 lb.	3.10	3.45-3.65
Flour, heavy in bbls.	Per 100 lb.	2.85	3.20-3.40
Tin chloride ($SnCl_2$) (crystals)	lb.	.41	.41½
Tin oxide (SnO_2) in bbls.	lb.	.62	..
Uranium oxide (UO_3) (black, 96% U_3O_8) 100 lb. lots	lb.	..	1.25-2.25
Zinc oxide (ZnO)	lb.	.06½	.07
Zircon			
Granular (Milled .005-.02c higher)		.07	.07½-.08
Crude, Gran. (Milled .005-.02c higher)		.03½	.04-.05

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to October 25, 1927

	September 1926 Quantity	September 1926 Value	September 1927 Quantity	September 1927 Value	Nine Months Ending September 1926 Quantity	Nine Months Ending September 1926 Value	Nine Months Ending September 1927 Quantity	Nine Months Ending September 1927 Value
Glass and glass products (total)	.....	$837,212	.....	$734,478	.....	$6,726,952	.....	$6,606,526
Flate and window glass—								
Window glass, common, box 50 sq. ft.	2,843	21,316	2,131	11,961	24,260	141,571	17,987	96,576
Plate glass, unsilvered, sq. ft.	35,060	14,386	64,237	23,417	763,588	207,206	769,619	248,682
Other window and plate glass	87,398	14,706	350,541	36,278	1,697,035	182,387	3,286,258	337,601
Glass containers (bottles, vials and jars)	.....	307,017	.....	297,913	.....	2,273,965	.....	2,344,202
Table glassware, plain	.....	148,535	.....	114,907	.....	1,220,758	.....	1,061,548
Table and other glassware, cut or engraved	.....	15,123	.....	9,318	.....	132,503	.....	103,069
Lamp chimneys and lantern globes	120,131	25,825	105,140	21,555	1,634,853	305 460	1,433,442	293,451
Globes and shades for lighting fixtures	175,912	61,856	102,857	43,921	1,301,652	430,516	1,244,940	457,297
Chemical glassware	21.134	18,123	17,149	15,449	164,107	150.843	153,703	138,740
Electrical glassware, except for lighting	176,413	35,185	116,547	19.017	4,170,378	372,682	1,740,597	180,327
Other glassware	.....	175,140	.....	140,742	.....	1,309,061	.....	1,345,033

IMPORTS

Corrected to October 25, 1927

Glass and glass products	.....	1,809,698	.....	1,458,863	.....	15,511.841	.....	12,562,219
Cylinder, crown and sheet—								
Unpolished	6,501,339	228,330	.....	.....	60,590,401	2,426,516	.....	.....
Weighing less than 80 pounds per case	.....	.....	3,463,960	95,615	.....	.....	36,537,575	949,306
Weighing 80 pounds or over per case	.....	.....	2,491,640	108,904	.....	.....	30,343,572	1,295,051
Bent, ground, beveled, colored, painted, etc., and polished	.....	37,423	.....	32,572	.....	413,917	.....	289,048
Plate glass	2,005,466	655,459	.....	.....	20,376,357	6,681,322	.....	.....
Polished, unsilvered	.....	.....	925,921	256,999	.....	.....	12,242,047	3 498,244
Other	.....	.....	143,379	33.304	.....	.....	934,902	221,113
Bottles, vials, jars, demijohns and carboys, molded or pressed	.....	17.737	.....	19.953	.....	207,504	.....	147,990
Table and kitchen utensils	.....	12,997	.....	17,511	.....	66,867	.....	105,912
Glassware, cut or decorated	.....	308,544	.....	361,808	.....	2,037,113	.....	2,640,450
Blown glassware, n. e. s.—								
Bottles, ornaments, gauge glasses and other n. e. s.	.....	281,041	.....	262,475	.....	1,293,940	.....	1,179,239
Bulbs for electric lamps	2,408,676	25,253	1,256,932	15,289	15,093,452	166,874	10,823,636	105,557
Chimneys, globes, shades, prisms and other illuminating glassware	.....	75,227	.....	79,267	.....	755,846	.....	669,994
Articles and utensils for chemical, scientific, and experimental purposes	.....	48,714	.....	45,408	.....	423,088	.....	397,493
Other glassware	.....	118,973	.....	129,758	.....	1,038,854	.....	1,062,822

The Glass Industry

THE MONTHLY JOURNAL OF

Glass Technology, Engineering, Raw Materials, Glass Factory Equipment and Operation

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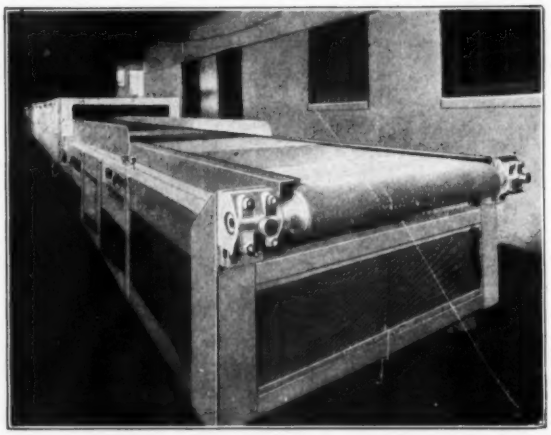

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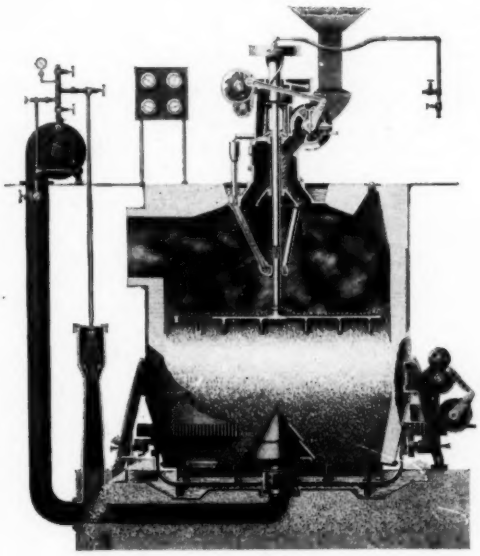

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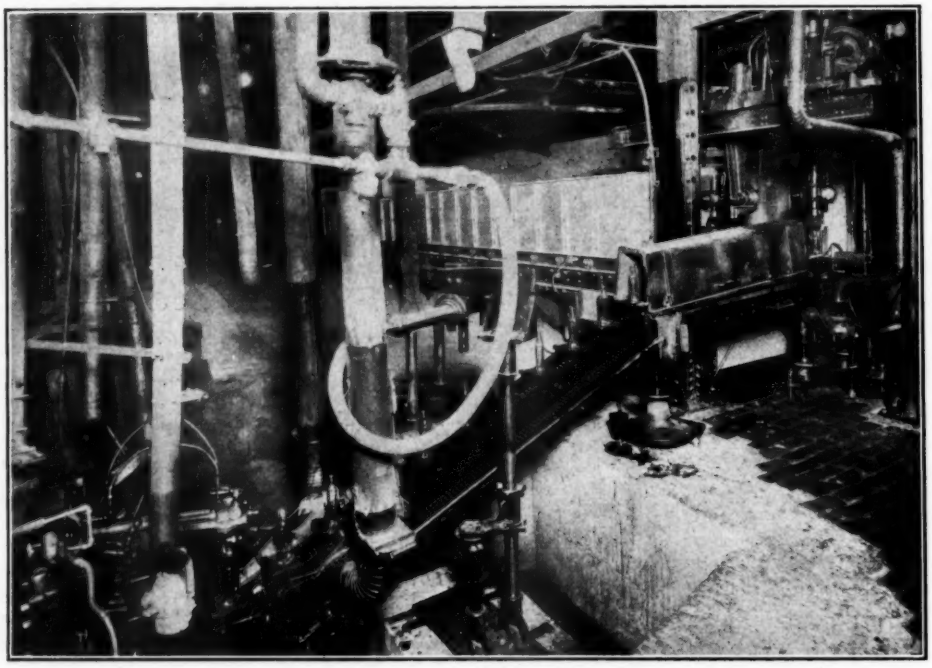

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Clean out all your old dusty iron-polluted glass-sand this month and fill your storage with

EVENMELT
Processed Glass Sand

so that you can start the new year under ideal working conditions for—

Maximum Output of Quality Products at Minimum Cost.

There is no surer way of safeguarding your business against the competition of imported wares, as well as of cut-price domestic products.

The "Fittest" Survive in Times Like These.

which means, the concerns that are able to reduce production-costs without a sacrifice of quality.

The fact that EVENMELT is *Dustless,* has *no oversize grains,* and contains 50% *less iron impurities* than ordinary glass sands, is enabling its users to

1. **Cut *Decolorizer* costs in two.**
2. **Reduce off ware and cullet to a hitherto undreamed-of minimum.**
3. **Speed up the melt.**
4. **Get a larger dollar value per dollar of *total production costs,* than *any* competitor who uses any other glass sand.**

You can prove the absolute truth of those four claims, without risk to yourselves, by acting on our—

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(And you hold the handle)

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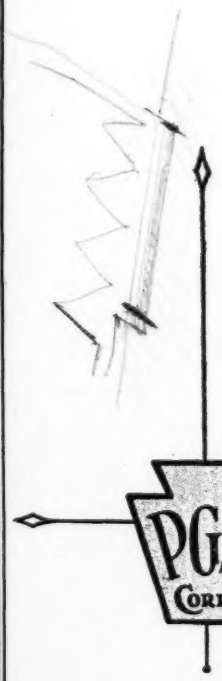
LEWISTOWN, PENNSYLVANIA



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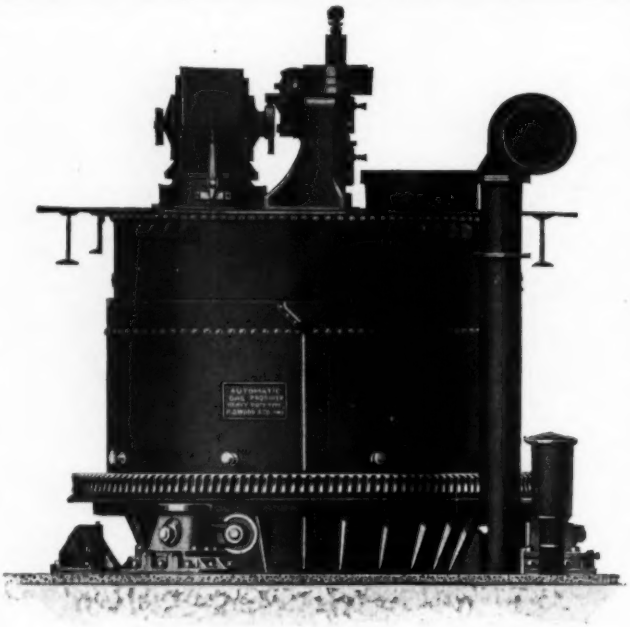

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The New Wood Heavy Duty Gas Producer is the result of twelve years' experience in the design, manufacture and operation of Automatic Gas Producers.

Every detail of the machine is built for HEAVY DUTY AND CONTINUOUS SERVICE

and for this reason the cost of upkeep is considerably less than with any other mechanical gas producer. It is by far the most **RELIABLE** machine on the market.

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CAST IRON PIPE, HYDRANTS AND VALVES

GLASS HOUSE MACHINERY

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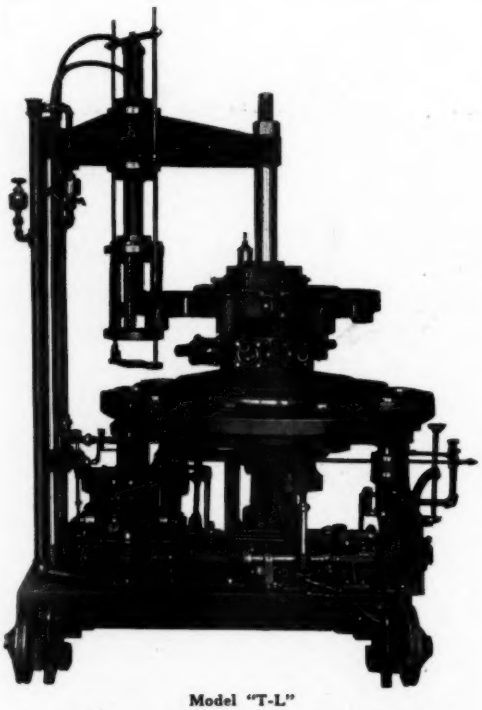
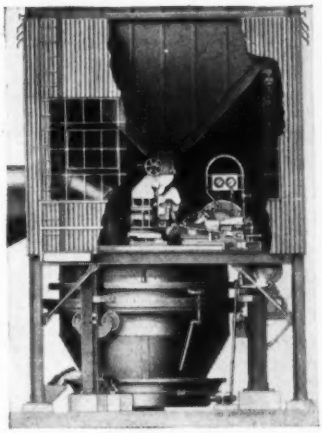


Model "T-L"

For tumblers and other block mold pressed ware

W-S-M TYPE "L"
GAS PRODUCER



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Since 1922 more than 230 Type "L" Gas Producers have been sold.

The Type "L" is noted for its increased gas-making capacity, more uniform gas flow and steady furnace temperatures.

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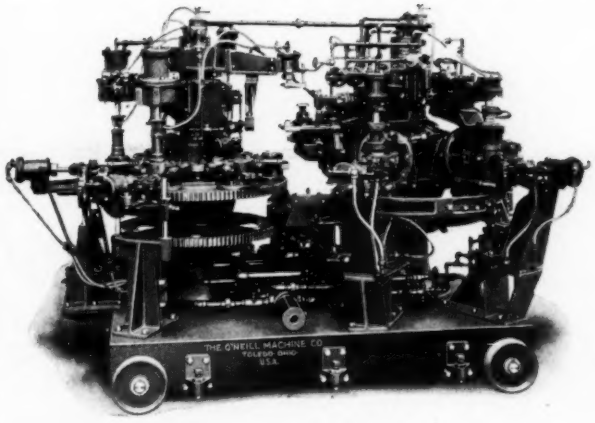
Bottle Blowing Machines



THIS machine will produce your small lines of ware as well as ware up to 8 oz. in capacity. We recommend this machine for the production of perfume, toilet water, prescription and a miscellaneous line of ware. This is one of our latest model blowing machines No. 48.

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SIMPLICITY COMPACTNESS

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Embodying Important Improvements Will Shortly Be Ready for Delivery

These improvements not only retain the **SUPREME RELIABILITY** which has been the leading characteristic of these splendid machines for the past 14 years but in addition they assure in regular service **GREAT INCREASE IN CAPACITY**

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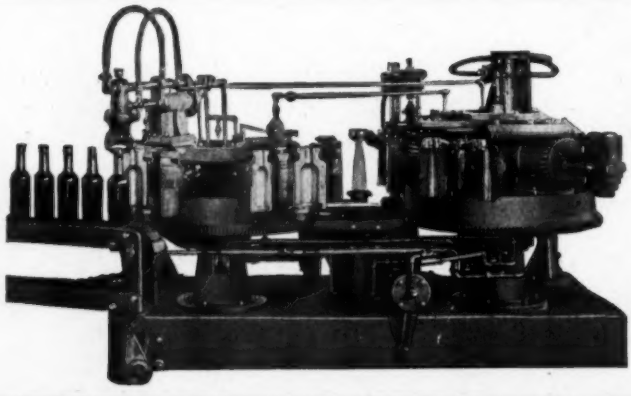

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Narrow Neck and Wide Mouth

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Strictly Automatic When Operated With Mechanical Feeding Device

Can be Operated by Hand Gatherers

Speed 10 to 32 bottles per minute, ranging in size from ½ oz. to one gallon.

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We manufacture sixty-two distinct models in one hundred and seventy-eight sizes. Light and heavy duty machines adaptable for automatic feeder or hand gather. Suitable for articles ranging in size from toy marbles to 75" x 26" x 18" glass containers. Salesmen in all leading countries.

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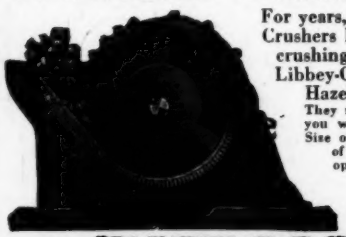

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CULLET CRUSHERS

SEPARATORS
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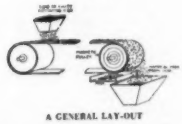
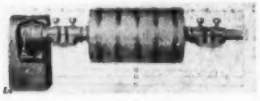


A GENERAL LAY-OUT



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If good metal in glass products will increase sales, the crushing of cullet and the magnetic separation of raw material should be given careful consideration.

The use of a cullet crusher or a magnetic separator or both will help maintain the uniformity of the metal in the finished product.

A letter will bring further details.

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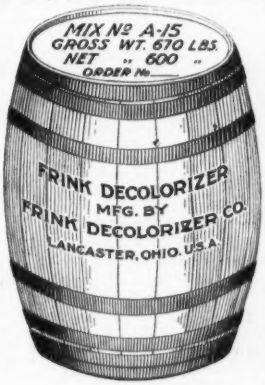

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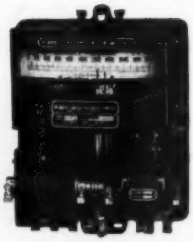

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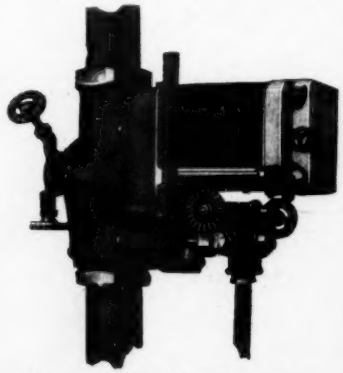

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